Wisconsin's Forestry Best Management Practices for Water Quality

The 2002 Statewide BMP Monitoring Report

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Acknowledgments

The dedicated support and cooperation of numerous people including Wisconsin Department of Natural Resource (DNR) staff, the forest products industry, natural resource professionals, private landowners and others made the 2002 statewide Best Management Practices (BMP) monitoring successful.

Statewide BMP monitoring was previously conducted in 1995, 1996 and 1997. Those involved with the baseline effort provided an enduring framework for the monitoring methods used in this study.

Dale Gasser, Forest Hydrologist for the DNR Division of Forestry, was the chief overseer of the BMP program in 2002. Among other duties related to the monitoring, Dale was responsible for conducting training workshops, organizing BMP monitoring teams, performing eligibility field checks and working with the BMP Advisory Committee.

The BMP Advisory Committee is a group of people that determine the strategy and methodology of BMP monitoring. The committee allows forest stakeholders to voice concerns and make decisions about the future of the BMP guidelines. The support of its members has been motivating and uplifting. More detailed information on the BMP Advisory Committee is presented in chapter one of this report.

A major task of the 2002 BMP monitoring effort was field checking. Intensive inspection, landowner contacts and research went into finding eligible timber sales on non-industrial private forests (NIPF). Working from a long list of randomly selected sales, DNR central office staff undertook most of the workload. Monitoring teams started inspecting sales in late September, at which point not enough eligible sales had been confirmed. The efforts of DNR field staff were requested to assist with the remaining field checks. Without their help, BMP monitoring would not have been completed in its anticipated capacity.

Perhaps the most valuable assistance came from the many team members who actually conducted the monitoring. Eight teams consisting of 46 people were needed to complete the inspections. Team members had a variety of backgrounds: industrial forestry, DNR, logging, United States Forest Service (USFS), conservation groups and others. Without these volunteers, the objectives of the 2002 BMP monitoring effort could not have been accomplished.

Seven team leaders were DNR staff and one was from the USFS. They spent a great deal of time contacting landowners, organizing team members, creating maps and planning team travel. Team leaders should be commended for their commitment to effective BMP monitoring.

Thank you to all people involved with the 2002 statewide BMP monitoring effort. Your assistance was valued and appreciated.

Foreword

Submitted by the BMP Advisory Committee.

The BMP Advisory Committee commends the DNR BMP program leaders and staff for their foresight and leadership in putting together a process to monitor water quality in relation to forest harvesting operations. Of particular note is that they saw value in creating an advisory group consisting of a wide diversity of interests from logger to nature protectionist whose common goal was the protection of our water resources. We especially appreciate how carefully and thoughtfully they listened to our concerns and suggestions, and even more so, that they acted on our recommendations. They allowed us to be an integral part of the process.

Executive Summary

Best management practices (BMPs) are practical and cost-effective guidelines to help loggers, equipment operators, landowners and natural resource managers protect water quality during forestry operations. In response to federal legislation, Wisconsin's Forestry BMP program was developed in 1995 by a partnership of many interest groups led by the Wisconsin Department of Natural Resources (DNR), Bureau (currently Division) of Forestry. This program is based on *Wisconsin's Forestry Best Management Practices for Water Quality: A Field Manual for Loggers, Landowners and Land Managers*. The program entails forestry BMP education, training workshops and BMP monitoring of timber sales.

The BMP program began with statewide monitoring during 1995-1997. In fall 2002, statewide monitoring was conducted again, with a total of 85 sales monitored. The key objectives of the BMP monitoring were to determine the extent to which BMPs were being applied throughout Wisconsin, the effectiveness of properly applied BMPs in protecting water quality and the effects of not applying BMPs where needed.

BMP monitoring consisted of field inspecting timber sales from six categories of land ownership: federal (3 sites were monitored in 2002), state (2), county (6), tribal (6), private industrial (8) and non-industrial private (60). Monitoring utilized visual assessments and professional judgments. Important characteristics of the 2002 monitoring methodology were:

- Monitoring was conducted using eight teams comprised of approximately six individuals from a variety of interest groups and areas of expertise.
- All team members were required to attend a BMP monitoring workshop in July to ensure consistent interpretations and methods among teams.
- Timber sales were randomly selected from a statewide database created from cutting notices, DNR tax law records and aerial surveys.
- To be an eligible site for monitoring, harvesting needed to occur on a wetland or within 200 feet of a lake or stream. Harvesting on the site also needed to be completed in 2001 or 2002.

Information from the monitored sales was collected and analyzed. Results are detailed in chapter three of this report. Highlights include:

- BMPs were correctly applied 86% (± 6%) of the time where needed on Wisconsin timber sales where harvesting occurred within 200 feet of a lake or stream, or on a wetland.
- When BMPs were applied where needed, 96% (± 6%) of the time monitoring teams observed no adverse impact to water quality.
- The frequencies of correct application of BMPs where needed for *Fuels, Lubricants, Wastes and Spills* (98% ± 7%) and *Timber Harvesting* (94% ± 3%) were significantly above the overall 86% (± 6%) mean.
- When BMPs were not applied where needed, 27% (± 8%) of the teams observed *no adverse impact* to water quality, 49% (± 12%) noted a *minor impact* rating and 26% (± 15%) recorded a *major impact*.
- Non-industrial private forests (NIPF) enrolled in a forest taw law program scored better with respect to the application of BMPs than NIPF lands not enrolled.

These overall results are very similar to the 1995-1997 study and indicate that Wisconsin has implemented an effective forestry BMP program. It should remain voluntary, combining existing guidelines and regulations with BMP education and training.

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Chapter One: Introduction

Clean water is essential to Wisconsin's economy and high quality of life. This water provides a habitat for wildlife, fish and other aquatic life. Our forests play a vital role in purifying and maintaining clean water in the state's lakes, streams, wetlands and groundwater. In addition, forests provide economic, ecological and social benefits such as wood products, wildlife habitat, clean air and recreational opportunities.

Within the context of forestry practices, water quality is degraded from one main cause: nonpoint source (NPS) pollution. NPS pollution occurs when surface water runoff from rainfall or snowmelt moves across or into the ground, picking up and carrying pollutants into streams, lakes, wetlands and groundwater. An example of a NPS pollutant is soil as it erodes and flows into a water resource. Eroded soil, or sediment, is the number one NPS pollutant affecting our nation's lakes, streams and wetlands (US EPA, 1992).

There are many land uses that can cause NPS pollution including agriculture, mining, urban and rural development, construction, and forestry. Nationwide, the U.S. Environmental Protection Agency estimates that between 5 and 9% of NPS pollution comes from timber harvesting activities (US EPA, 1997). Because Wisconsin is relatively, it is estimated that forest practices generate about 5% of the state's NPS pollution (WDNR, 2003). While 5% sounds small and insignificant, localized NPS pollution can be considerable.

In 1977, Section 208 of the federal Clean Water Act was passed, requiring each state to develop plans and procedures to control "silviculturally related nonpoint sources of pollution…to the extent feasible." Section 319 of the 1987 federal Water Quality Act further required each state to develop and implement a program to reduce NPS pollution to the "maximum extent practicable." In response to this federal legislation, the Division (formerly Bureau) of Forestry in the Wisconsin Department of Natural Resources (DNR) developed the Wisconsin's Forestry Best Management Practices (BMP) for Water Quality program in 1995.

Wisconsin's Best Management Practices Program

Wisconsin's Forestry BMPs are practical and cost-effective guidelines developed to assist loggers, equipment operators, landowners and natural resource managers in protecting water quality during forestry operations. BMPs for Wisconsin are explained in *Wisconsin's Forestry Best Management Practices for Water Quality: A Field Manual for Loggers, Landowners and Land Managers.* This manual is available free of charge from the Wisconsin Department of Natural Resources, Division of Forestry (WDNR, 2003).

It is important to recognize the voluntary nature of Wisconsin's Forestry BMPs. The Wisconsin DNR strongly encourages the use of BMPs through education and training rather than regulations. Most states in the U.S. either have a regulated forestry BMP program with forest practice legislation or a voluntary forestry BMP program with water quality regulations (NCASI, 2001). Consistent with the conclusions of Ice and Nettles (1999), the Wisconsin DNR believes that a *voluntary* BMP program, along with existing water quality regulations, will have the greatest success in protecting water quality during forest management activities. With BMP education and training workshops and the random monitoring of timber sales, Wisconsin expects to have a voluntary program that is as effective or more effective than a forest practices regulatory program, and at a fraction of the cost.

BMP Education and Training Workshops

Since 1994, over 4,000 people have attended a BMP education and training workshop. The attendees have primarily been loggers, but foresters and a few private landowners have also attended. With the inception of the Sustainable Forestry Initiative® (SFI®), loggers are now required to take BMP training once every 5 years. The Forest Industry Safety and Training Alliance, Inc. (FISTA) continues to provide these workshops each year in cooperation with the Department of Natural Resources. Workshops typically consist of a morning classroom session with a variety of speakers who have field experience using BMPs. In the afternoon, workshop attendees travel by bus to a nearby field site to discuss possible water quality impacts from forest practices. Discussions typically focus on BMPs for forest roads at stream crossings and BMPs for harvesting next to lakes and streams or within a wetland. FISTA offers BMP workshops from April through December. Schedules and locations of upcoming workshops are available through the Division of Forestry or from FISTA.

BMP Advisory Committee

In November 2001, the DNR convened an external BMP Advisory Committee to help formulate the monitoring strategy for 2002 and beyond. The Advisory Committee provides leadership, advice and guidance to the statewide voluntary implementation of Forestry BMPs for Water Quality which is supported by a broad range of forestry interest groups. The committee works together in partnership with the DNR to strategically position Wisconsin as a leader in this voluntary approach to address federal forest water quality concerns. This group of advisors is committed to the long-term maintenance and continual improvement of water quality when implementing forest management activities. The committee has also targeted opportunities for forestry BMP education and outreach initiatives. Through these efforts, the committee hopes to enhance relationships between and within interest groups and the DNR by investing time and effort into this voluntary approach that is a part of the sustainable management of Wisconsin's forests.

Membership

The current committee has 14 members in addition to DNR staff. The membership of the committee is very similar to that of the original four committees that assisted the DNR with the creation of our Forestry BMP for water quality program. The committee members represent 1,000 Friends of Wisconsin, Governor's Council on Forestry, International Paper, Lake States Lumber Association, Wisconsin Paper Council, Society of American Foresters, Stora Enso North America, The Nature Conservancy, Timber Producers Association of Michigan and Wisconsin, U.S. Forest Service State & Private Forestry, Wisconsin Association of Lakes, Wisconsin County Forest Association, Wisconsin Professional Loggers Association, and the Wisconsin Woodland Owners Association.

Charge

The committee had four meetings from December 17, 2001 to March 26, 2002. The initial charge of the committee, which was developed in the first few meetings, follows:

In order for Wisconsin to implement BMP monitoring in 2002 and beyond the committee will:

- Consider revising Wisconsin's statewide monitoring strategy for Forestry Best Management Practices for Water Quality monitoring.
- Develop a procedure for identifying and updating best management practices that need revision.
- Develop a procedure for communicating BMPs and adaptations through education and outreach strategies.

During the course of the four meetings, the committee evaluated and gave the DNR (1) feedback on the BMP monitoring methods used during 1995-1997 and (2) guidance on potential monitoring options for 2002. The committee also assisted the DNR with establishing a procedure for updating individual BMPs, included as Appendix A. The committee has defined a long term advisory role for the continual improvement of Forestry BMPs for Water Quality in Wisconsin.

Monitoring Objectives

The committee wanted three primary outcomes from BMP monitoring:

- Determine the extent to which BMPs are being applied throughout Wisconsin;
- Determine the effectiveness of applied BMPs in protecting water quality; and
- Determine the effects of not properly applying BMPs where needed.

The implementation of these objectives was critical for monitoring success and in meeting the charge of the committee.

The 2002 Monitoring Effort

In order to meet their charge, the BMP Advisory Committee decided that 2002 statewide monitoring was necessary. The relationship of this report, which is the product of the 2002 monitoring activities, is to fulfill the committee's monitoring objectives and therefore part of their charge.

Relationship to the Charge

The charge of the BMP Advisory Committee is not specifically addressed in this report. However, the committee, along with guidance from DNR leadership, will use the results presented in this report to autonomously address their charge.

Relationship to the Monitoring Objectives

The monitoring effort was solely designed to meet the monitoring objectives of the committee. In addition to the three main objectives, several side objectives were formulated. Definable for the 2002 monitoring effort only, the BMP Advisory Committee was also interested in:

- Determining if BMPs were used more often and correctly in 2002 based upon the results of the 1995-1997 study, further requiring;
- Identifying the effectiveness of the BMP education and training workshops and what modifications may be needed;
- Documenting the impacts of forestry activities on water quality for use by the general public and various decision makers;
- Educating landowners, loggers and foresters involved in sites that are monitored;
- Fostering understanding among groups involved in the monitoring efforts;
- Providing feedback on monitoring program design;
- Identifying research and information needs;
- Identifying where modifications may be needed in the BMP field manual; and
- Evaluating if regional BMP efforts may enhance individual statewide efforts.

Ultimately, it is expected that the results of this report will justify the protection of our water resources in a *voluntary and cost-effective manner*, avoiding expensive government regulation.

Chapter Two: Methods

Following the recommendation from the BMP Advisory Committee, the Division of Forestry conducted the 2002 BMP monitoring. Generally, the monitoring evaluated the application and effectiveness of BMPs on timber sales that were completed in either 2001 or early 2002. Three years of BMP monitoring (1995-1997) had preceded this effort. To preserve consistency in monitoring, the methodology of the 2002 effort was similar to that of the previous three-year study.

BMP monitoring was conducted in four steps: (1) the selection of monitoring team members, (2) the identification of eligible timber sales, (3) monitoring and (4) analysis. Arranged chronologically, these steps are described within this chapter. The biases and limitations of this study are listed at the chapter's end.

Monitoring Teams

Member Selection

Monitoring involved teams visiting and evaluating timber sales, where at each sale the team determined if and to what extent BMPs were applied. To ensure creditable monitoring results, monitoring teams were comprised of people with a broad range of interests and expertise. The Division of Forestry solicited team members from: county, state and federal agencies; the University of Wisconsin Extension; professional forestry organizations; environmental and conservation organizations; and the timber, pulp and paper industries.

Members were selected to fill eight monitoring teams, with about six members comprising each team (Appendix B). Five of the six team members represented forest management, logging, soils, water quality, or an established environmental or conservation organization. The sixth person served as a team leader and was either a DNR or USFS forester.

July 2002 Training

The training workshop was created based on three objectives: familiarize the team members with the monitoring process, disseminate the design of the monitoring worksheet and calibrate teams. The training was conducted over a two-day period, where the first consisted of in-class overview and the second of field trips. The July 2002 workshop was similar to the 1997 calibration workshop.

Selection of Timber Sales to Be Monitored

Methodology

For the purposes of this project, landowners were divided into six categories. The largest of these categories was the non-industrial private forest (NIPF). Characteristics of the NIPF included private fragmented ownership. Seventy-one percent of the sales monitored were NIPF.

Industrial ownership was a second category. Sales qualifying within this group were principally planned for the procurement of fiber to mill operations. These landowners managed large areas of forest with an industrial approach. Tribal ownership, a third landowner category, was identified based on the private ownership of forest by a Native American Nation, such as the Menominee.

The last three types of landowner categories were county, state and federal. These categories were identified based on public ownership and management by level of government. Only county and federal forests were considered for their respective land categories. All state-owned lands managed by the DNR were included in the state category.

The methodology for the selection of sales consisted of three steps: (1) identify sales by landowner category, (2) randomly select timber sales in a proportion to the total number of sales in each stratum and (3) field check the selected sites for the compilation of all monitoring criteria.

Determining the Target Number of Sales

It was determined that a minimum of 80 sales needed to be monitoring to estimate overall application percentage to within 10%. A stratified random sample was used, where the number of sales selected for sampling was proportional to the number of sales conducted within each landowner category. The 1995-1997 study was used as a pilot sample. Previous estimates of mean frequency and confidence intervals served to more accurately determine the number of sales needed.

Sources of Timber Sale Records

Timber sale records for NIPF sales were obtained from four sources: aerial surveys, cutting notices, Managed Forest Law (MFL) inventory and Forest Crop Law (FCL) inventory. The use of satellite imagery to locate timber sales was not used in 2002, since this method was found to be extremely inaccurate in 2001 when the DNR used this approach for locating timber sales in the Kickapoo River water watershed in Southwest Wisconsin. Only records of timber sales completed after January 1, 2001 were considered.

Aerial surveys were conducted over 11 randomly selected counties in the southern half of Wisconsin and produced few eligible sales. Often the observations of apparent timber sales were too old, not large enough or were not actually timber sales. Aerial surveys entailed photographing sales and taking Global Positioning System (GPS) location points. For a statewide monitoring effort, the investment of time and money exceeded the benefit of conducting these surveys. The costs of aerial surveys are discussed in chapter four.

Cutting notices were collected from state and county offices. In Wisconsin, all landowners are required to file a notice with their county clerk before cutting any trees on their property that will be sold as timber, pulp, firewood, or Christmas trees. Often landowners were unaware that a notice needed to be filed, the law was not enforced or landowners avoided filing, which resulted in an incomplete record source. This is discussed with more detail in the Bias and Limitations section of this report. MFL and FCL databases held an inventory of about 26,870 enrolled NIPF landowners.

County, state, federal, private industrial and tribal sales were more easily identified. Information on every landowner within these categories was readily available. Each landowner was contacted and asked to provide a list of timber sales that they conducted. From this list, random sales were selected and eligibility was confirmed. Only three of eleven tribes chose to participate in BMP monitoring.

Field Checking of Timber Sales

All timber sale records were complied into lists and arranged in random orders. In accordance with the stratification, an appropriate number of records were selected for each landowner category. During the months of July to October, selected sales were field checked for eligibility by DNR staff. In total, 337 sales were checked for three criteria:

- Did harvesting occur on a wetland or within 200 feet of a lake or stream?
- Was harvesting on the timber sale completed in 2001 or 2002?
- Does the landowner give permission for a monitoring team to visit the timber sale on their property?

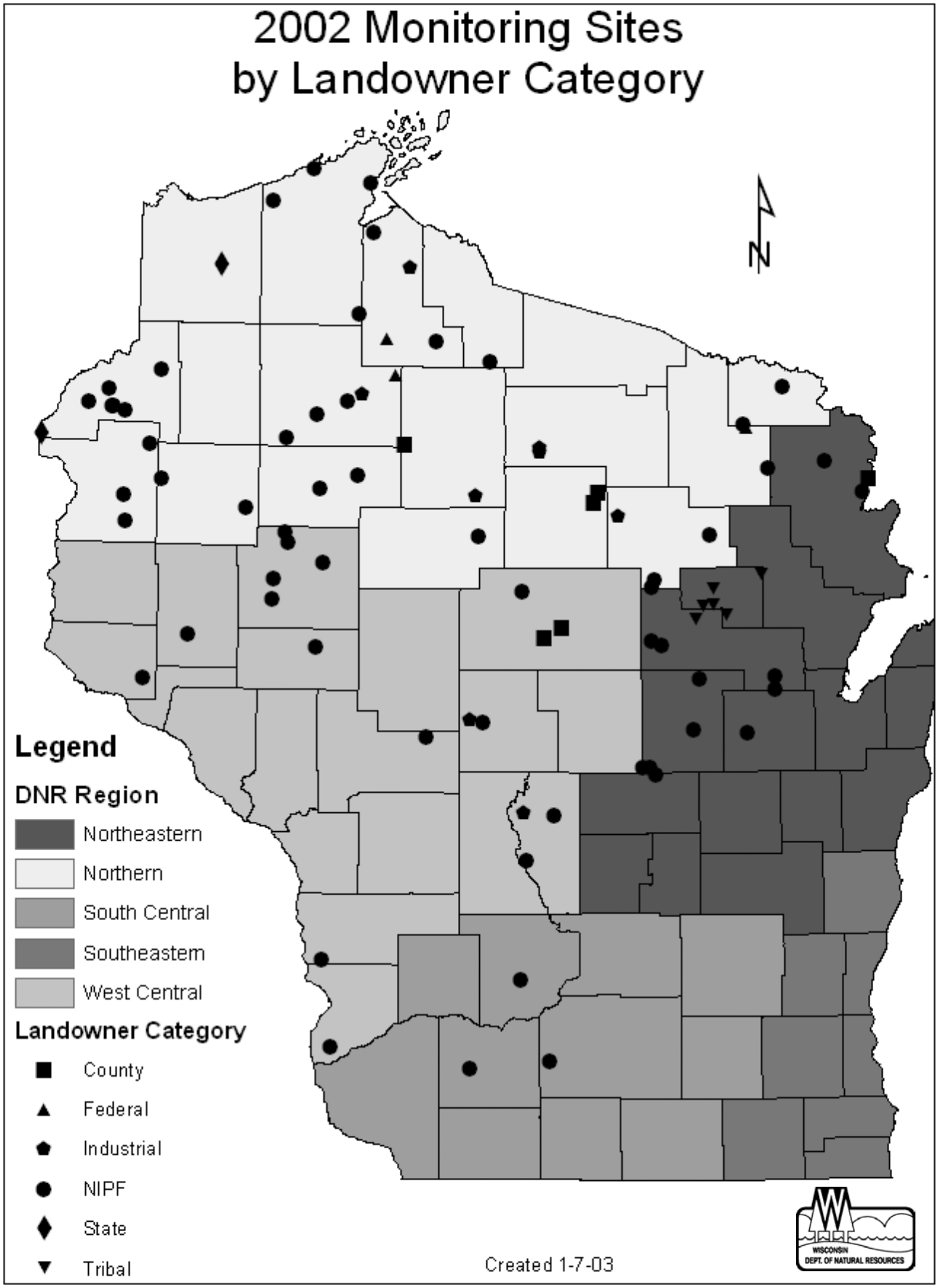

Figure 1: Locations of monitoring sites by landowner category.

An Eligibility Criteria Worksheet (Appendix C) documented each field check and served to provide a record of qualifying sites. DNR staff secured permission for monitoring activities and distributed eligible sites to team leaders for actual monitoring.

Monitoring of Timber Sales

Monitoring was conducted September, October and November. A total of 24 team-days, or about 144 person-days, were contributed to inspections. Eighty-five sites were visited during this period of time.

Distribution of Timber Sale Locations

Figure 1 illustrates the locations of the 85 timber sales monitored in 2002. The distribution of sales was wider than the previous three-year study. The Menominee Indian Tribe owns and manages lands within Menominee County. They accounted for the majority of participating tribal sales in the state, hence the clumped distribution of tribal sales near Menominee County. A comparison of sites monitored by DNR region and by year is represented in Figure 2.

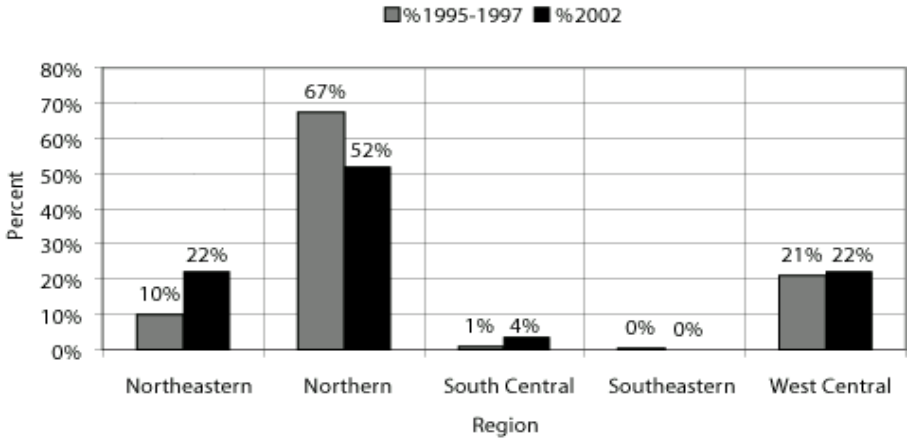

Figure 2: Percent of monitored sales by DNR region for 1995-1997 and 2002.

Distribution of Timber Sales by Landowner Category

Seventy-one percent of the sales monitored were on NIPF ownership. Compared to 1995-1997, the proportion of NIPF sales sampled increased from 57 to 71%. The proportion of state sales sampled decreased from 7 to 4%. Figure 3 illustrates the percentage of sales monitored by landowner category. NIPF sales accounted for most of the field checks. The number of NIPF field checks for each county is shown in Figure 4.

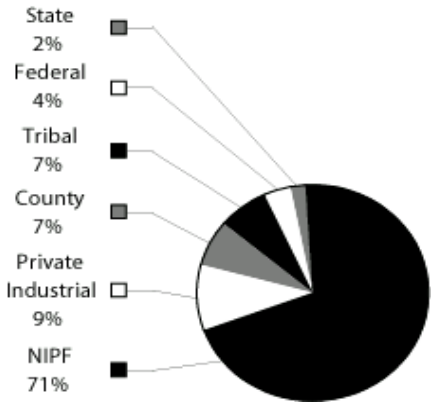

Figure 3: Percent sales monitored in 2002 by landowner category.

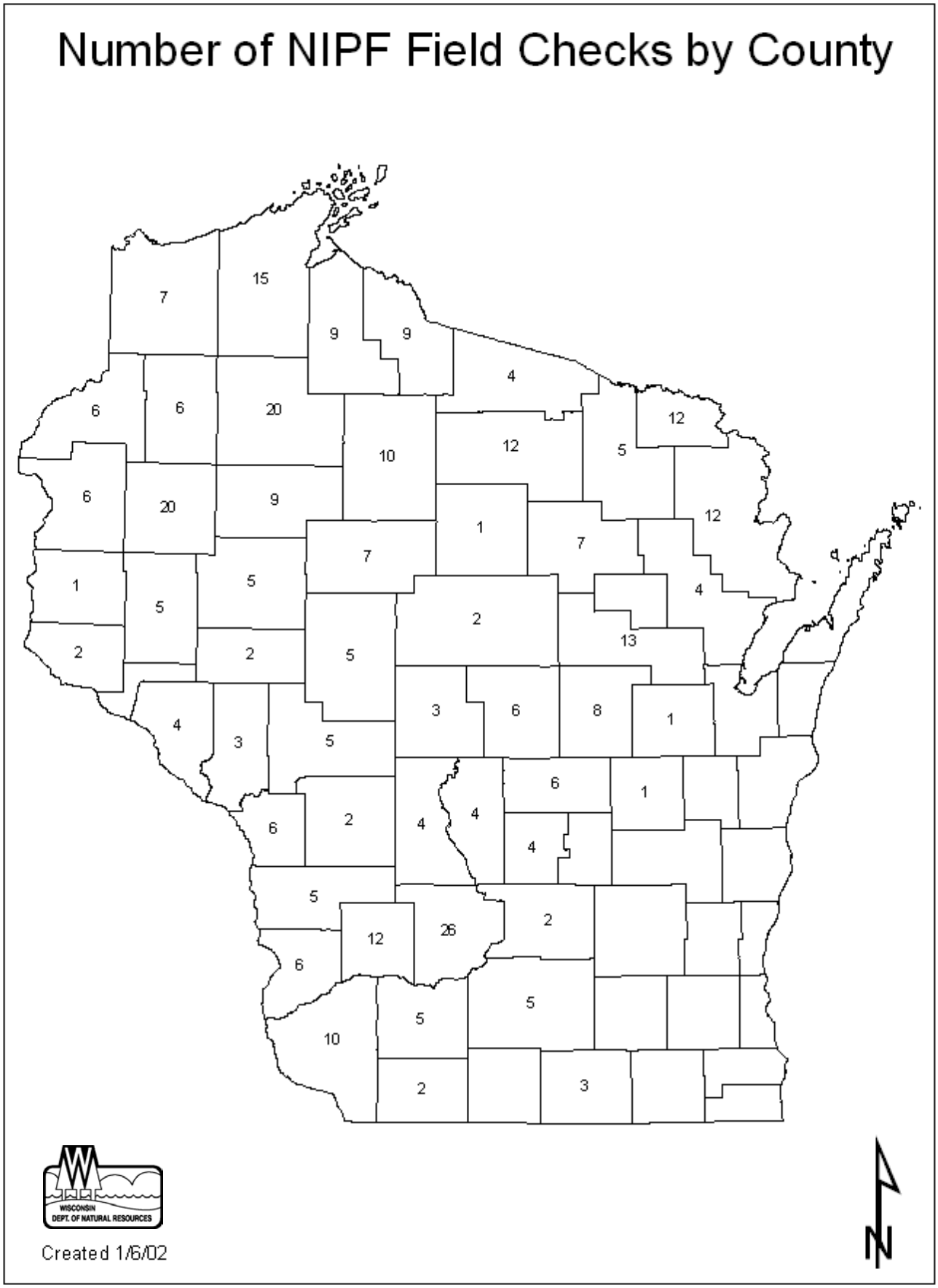

Figure 4: Number of NIPF field checks by county.

Field Procedures

Team leaders received a copy of the eligibility criteria form for each sale to be monitored, a road atlas, a supply of monitoring worksheets and a GPS unit prior to monitoring. In some instances, team leaders may have received copies of aerial photos, MFL property maps, plat book maps, field check maps or timber sale contracts.

Team leaders were responsible for contacting landowners and coordinating team members prior to the monitoring date. Team leaders were also responsible for arranging times and locations to meet with landowners interested in observing the inspections.

Team members traveled to and observed timber sales as a group. Observation included thoroughly walking the site, examining roads, and inspecting stream or wetland crossings. Measurements were taken for slope, basal area and Riparian Management Zone (RMZ) width.

A GPS unit was used to collect spatial information, such as the locations of water crossings, excessive rutting, seeps and springs. The GPS unit was also used to track the movement of the teams. All GPS data was downloaded by team leaders or a designee at the end of each day's observations. The data was later used to produce a site map of each sale for future reference or potential for re-monitoring.

On the first day of observations, a DNR central office employee accompanied each team. This served to establish consistency between teams. At this time, central office staff was available to provide GPS training and answer questions.

Monitoring Worksheet

The 2002 BMP Monitoring Worksheet consisted of four parts: application and effectiveness rating, supplemental questionnaire, professional judgment rating and NIPF landowner survey (Appendix D). To maintain consistency between monitoring teams, guidelines for the monitoring were included with the worksheet (Appendix E).

The worksheet was filled out onsite or relatively soon after visiting the site. Only the monitoring team members were allowed to fill out the worksheet. One worksheet was filled out per site, requiring that consensus be met before finishing. Team members marked appropriated responses for application and effectiveness ratings on the right hand side of every page. Ratings for effectiveness were only recorded where application ratings were other than zero or four (*Not applicable to site* or *Insufficient information to rate*). Effectiveness ratings were qualitative in nature. Team members were also encouraged to supply comments with their ratings.

Supplemental Questions

Supplemental questions were included throughout the worksheet. Questions were asked about the management during harvest, site conditions, water resources and timber harvest. Questions were fairly objective and were filled out collectively by team members.

Professional Judgment Ratings

Professional judgment ratings were recorded for every site, decided jointly by team members. Also referred to as *overall ratings*, these responses were only used to generalize the application and effectiveness of BMPs on any particular site. This generalization was solely used as a measure to inform landowners how their sale scored during the inspection. The ratings held no statistical significance and were not used for estimations within this report.

Landowner Survey

NIPF landowners were surveyed by either team leaders or by central office staff. The survey was designed to obtain information supplemental to that collected in the field. The survey was not designed to yield statistically relevant data. Therefore, no strong inferences can be made regarding the information collected. The NIPF landowner survey is found as part of Appendix C.

Data Analysis

After completion of field monitoring, DNR staff entered the data into a Microsoft Access database for storage and analysis. Both staff in the Division of Forestry and Bureau of Integrated Science Services analyzed the data. Since a number of attributes were collected at each site, and the number and type of attributes differed between sites, the sampling design used was single stage cluster sampling (each sale was a cluster). The same sampling design was used in all previous studies. Variance estimates and confidence intervals were calculated using the methods outlined in Cochran (1977).

A "p" value and a 95% confidence interval are used to provide statistical significance:

- When $p \leq 0.05$ there is a significant difference between two values being compared; when $p>0.05$, there is no statistically significant difference between the two values being compared.
- A 95% confidence interval means that we can be 95% confident that the true number is within the interval. For instance, when we write "86% ($\pm$ 6%) of Wisconsin timber sales apply BMPs correctly where needed", we are 95% confident that the true value is between 80% and 92%.

Bias and Limitations of the Monitoring Methods

There were three primary opportunities for bias in sampling timber sales:

- Information on NIPF timber sales was obtained primarily through the collection of timber sale cutting notices filed with county clerks throughout the state. According to Wisconsin State Statue 26.03, landowners are required to file a cutting notice with their county clerk prior to harvesting timber on their forestlands. However, some counties, particularly in southern Wisconsin, do not enforce the Statute and some forest landowners are unaware that the Statute exists. In addition, certain landowners purposefully do not file a cutting notice.
- Duplicate or triple records may have been recorded for NIPF timber sales. Sales in some counties may have been recorded by cutting notice, MFL database query and aerial survey. Multiple entries of a single sale increased the probability that it would be selected.
- Only three tribes in Wisconsin granted permission for BMP monitoring. Some sales were not included, resulting in a biased sample.

There were several limitations to the design of the monitoring methods:

- There were many situations that made it difficult to determine if a sale met the monitoring criteria or not. For instance, some timber sales were harvested over a period of time, such as three consecutive years. When only one part of the sale was near a water feature, sometimes it was difficult to determine if that part was harvested the previous year, in which case it met the criteria, or two or three years earlier, in which case it did not meet the criteria.
- In some instances, sales were determined to be ineligible for monitoring when the team arrived at the site. In every one of these cases, public lands and private industrial staff who were not completely aware of the criteria mistakenly confirmed eligibility. For these ineligible sales, a substitute sale was monitored. Conversely, some landowners may deliberately conclude that a sale is ineligible in order to avoid monitoring by a BMP team.
- On occasion, landowners on public and private lands deliberately identified a "no-cut" zone of *greater* than 200 feet next to a stream. These timber sales did not meet our monitoring criteria, yet these were exceptional timber sales with respect to identifying a riparian management zone and protecting water quality.
- Conversely, a "no-cut" zone may have been purposefully designed to be narrower than the recommended width. The product of a valid management objective, this narrow zone was misread by monitoring team members. Lower than normal scores for some BMPs may have been recorded.

- Because teams monitored timber sales up to 21 months after completion of the harvest, extensive ground cover may have been present which made observations of ground conditions difficult. As a result, evidence of water quality impacts that may have occurred shortly after harvest may not have been detected.
- Similar to the previous limitation, snow cover may have been a factor.
- Whether or not a BMP was needed, and therefore rated, on a site often depended on the water resource(s) on the site. The water resources are legally defined in Wisconsin as a "stream", "lake" or "wetland". Despite moderate training on the subject during the July workshop, teams sometimes had a difficult time determining (1) the difference between a lake and a wetland with standing water in it and (2) the difference between navigable and non-navigable streams. As a result, some BMPs may have been rated where they should not have, while others may not have been rated when applicable.
- Monitoring team members commented that there were situations when they were not sure if they should use an application rating of (0) *BMP not applicable to the site* or (4) *Insufficient information to rate*. However, this did not affect application ratings 1, 2 and 3 (see chapter three: Results and Discussion).
- BMP A1 (Collect all waste lubricants, containers and trash) should be needed on every timber sale since infiltration of fuels, lubricants and other chemicals into groundwater can occur to some extent on any timber harvest. However, in each year of monitoring, as Appendix F shows, for BMP A1, there was one sale where the BMP was *not applicable to the site*. This issue has been and will continue to be addressed at BMP monitoring workshops.
- Rating timber sales for effectiveness was accomplished using a point-in-time qualitative visual observation of the site, most often looking for signs of erosion and sedimentation. Since this qualitative evaluation was not as precise as a more expensive quantitative evaluation, there may have been some differences in the ratings among the monitoring teams. Nevertheless, the methodology used provided valuable analysis of the use and effectiveness of BMPs in a cost-effective manner.
- Although the definitions for the *minor* and *major* effectiveness ratings were defined, a range of interpretation between the teams still existed. In continuance with the 2002 training workshop, future monitoring will focus on defining the effectiveness ratings using enhanced examples and explanations.
- Sample sizes were large enough to estimate the overall application with a confidence interval of less than +/- 10% for all landowner categories together and individually for the NIPF category. Estimates and confidence intervals for the other individual landowner categories should be interpreted cautiously because of their small sample sizes.

Chapter Three: Results and Discussion

All results in this chapter are derived from monitoring team responses. Monitoring teams primarily responded on the application and effectiveness of 128 different BMPs. These results do not reflect all sales in the state, only those were harvesting occurred on a wetland or within 200 feet of a lake or stream (see Appendix B).

Within the first two sections of this chapter (BMP Application and BMP Effectiveness), the primary results are presented and possible trends are identified. The information within these two sections addresses all three monitoring objectives. The following section (BMP Application, Effectiveness, and Statistical Significance) encapsulates a brief discussion of the primary results and trends, within the context of statistical significance. The last section (Other Components of the Monitoring Worksheet) documents some of the additional information collected during monitoring.

BMP Application

The Five BMP Application Ratings

Monitoring teams chose one of the following five responses for the application of each BMP on a specific timber sale: (0) *BMP not applicable to site*, (1) *BMP applied correctly*, (2) *BMP applied but incorrectly*, (3) *BMP not applied* or (4) *insufficient information to rate*. Responses are broken-down by individual BMP and application rating in Appendix F. Figure 5 is a comparison of the frequencies of responses for an average monitoring site.

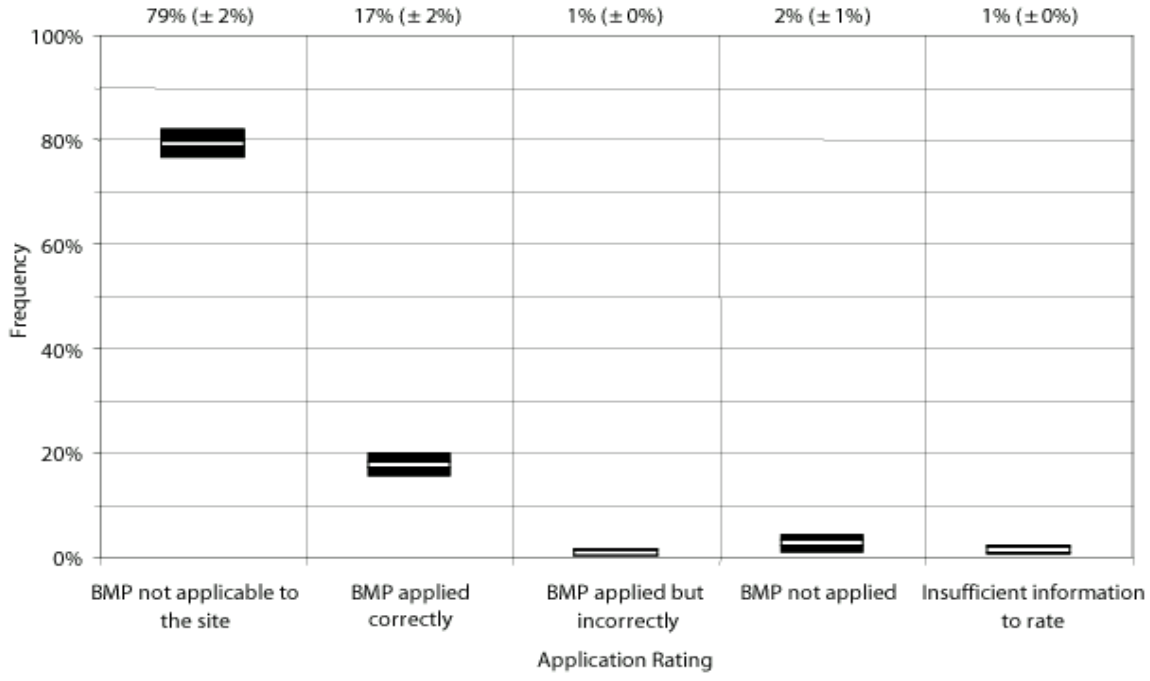

Figure 5: Frequencies of application ratings for 2002 monitoring, with 95% confidence intervals. Data presented represents timber sales on a wetland or within 200 feet of a lake or stream.

Overall BMP Application

Overall, 86% (±6%) of the time BMPs were correctly applied where needed. There is no statistically significant difference ($p>0.05$) between the 1995-1997 results and the 2002 result. Figure 6 is a comparison of overall correct BMP application rates since baseline monitoring was conducted in 1995.

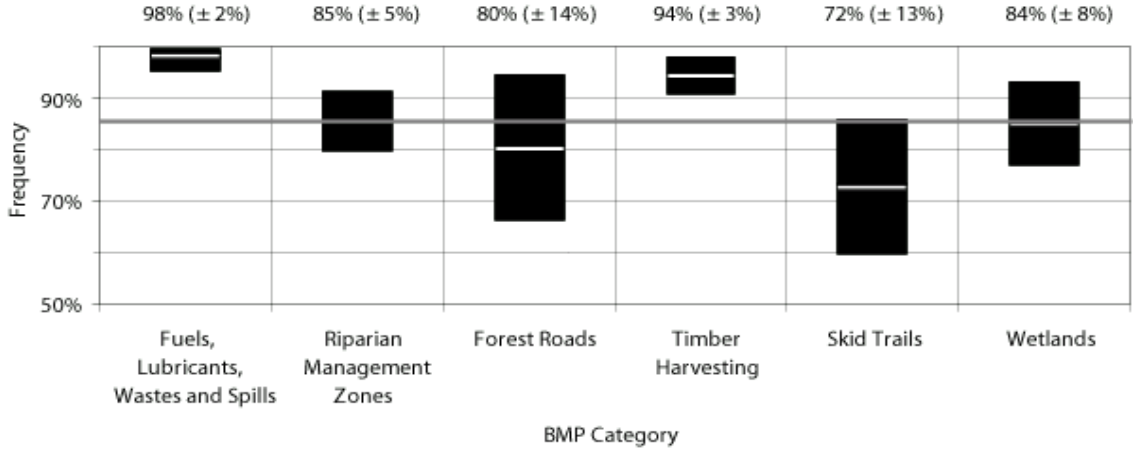

Figure 6: Overall application rates of BMPs where needed for 1995-1997 and 2002 studies, with 95% confidence intervals. The bold horizontal line represents mean overall application (85%) across all years. Data presented represents timber sales where harvesting occurred on a wetland or within 200 feet of a lake or stream.

Trends of Overall BMP Application

Two possible trends for overall BMP application may exist. First, BMP application may be increasing. Although statistically indifferent, estimates for the mean correct application of BMPs presented in Figure 6 have increased about one percentage point every year monitoring has been conducted. Figure 7 illustrates the trend of overall BMP application.

Variance has been decreasing over time, which may indicate more consistent application of BMPs about the mean. Figure 8 shows the trend in variance.

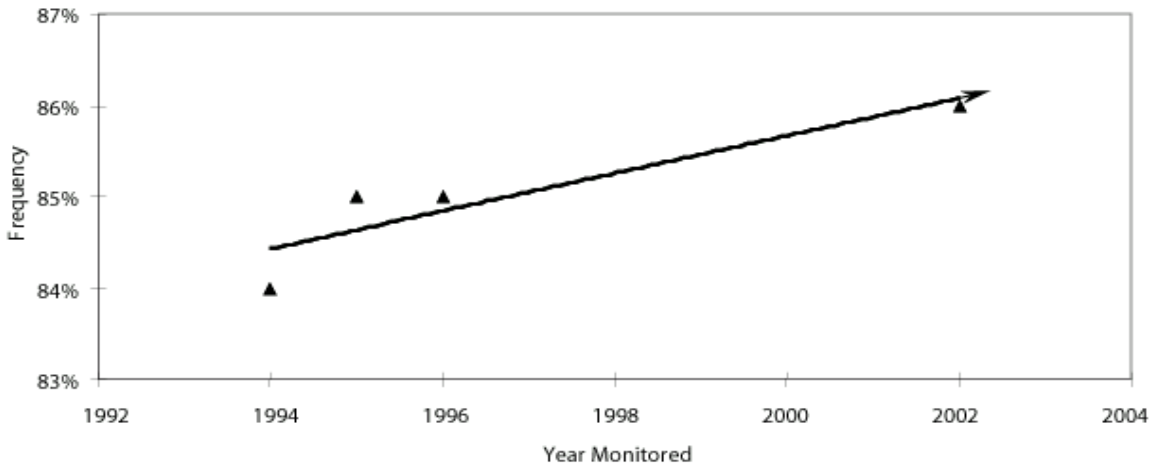

Figure 7: Trend of overall application rates of BMPs where needed over time. Based on data from 1996-1997 and 2002 studies. Data presented represents timber sales where harvesting occurred on wetland or within 200 feet of a lake or stream.

Although these trends may appear to be significant, only four years of data exist. In addition, variance within each monitoring year was fairly high. Generally, estimated mean and corresponding variances appear to be following these trends.

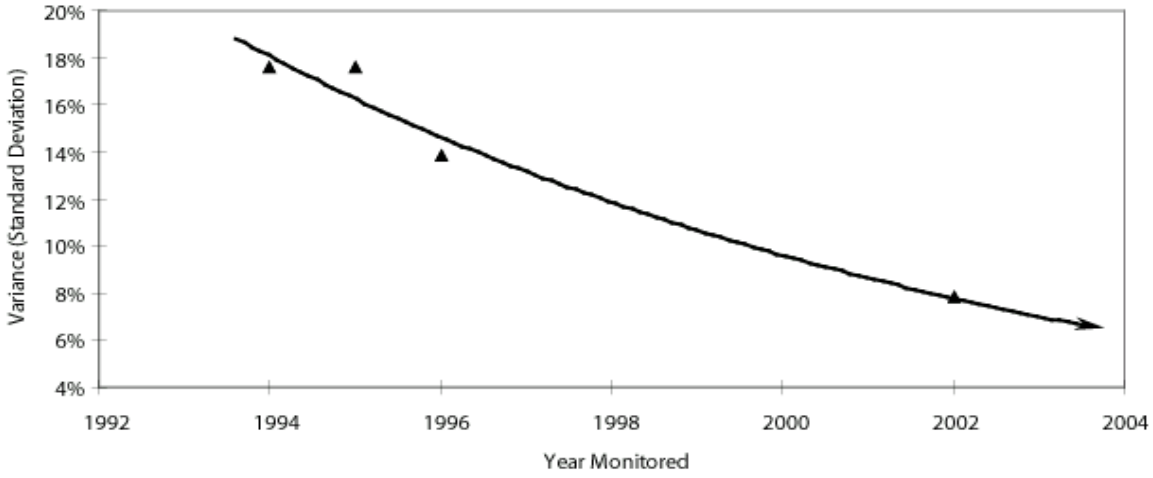

Figure 8: Trend of variance over time, represented as standard deviation, based on data from 1995-1997 and 2002 studies. Data presented represents timber sales where harvesting occurred on a wetland or within 200 feet of a lake or stream.

BMP Application by Landowner Category

Figure 9 is a comparison of the frequencies of correct application of BMPs where needed for each of the six landowner categories. Correct application where needed was significantly lower for NIPF ownership sales than for industrial, federal, or state sales, but was not significantly different from county sales ($p \leq 0.05$). All other landowner categories were not significantly different from the mean ($p>0.05$). State ownership rated the highest with 100% compliance. This is misleading because only two state sales were monitored, compared to 60 NIPF sales. The only statistically valid estimate is that for the NIPF category.

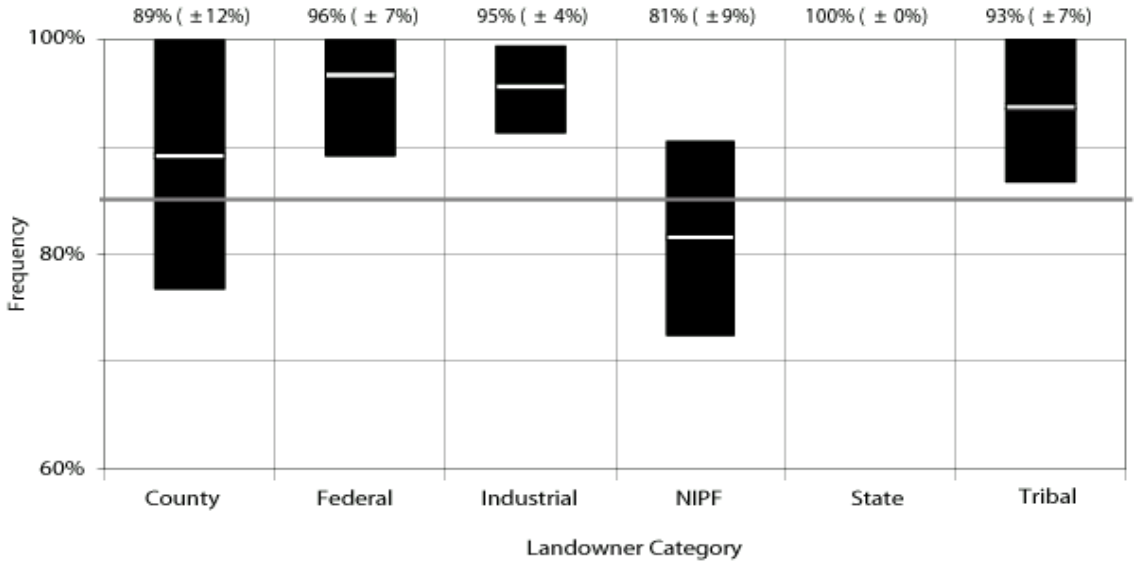

Figure 9: Frequencies of correct application of where needed for the six landowner categories, with 95% confidence intervals. The bold horizontal line represents mean application (86%) of all landowner categories. Data presented represents timber sales where harvesting occurred on a wetland or within 200 feet of a lake or stream.

Changes in BMP Application by Landowner Category

Estimates for correct application by landowner category are compared in Table 1. Generally, correct application increased across all landowner categories except tribal. Statistically, all estimates are the same ($p>0.05$). To reiterate, sample sizes for individual landowner categories other than NIPF are probably not large enough for large sample approximations for confidence intervals to be valid.

Landowner Category	Frequency of correct application where needed, with 95% confidence interval (1/2 width)		Difference
	1995 - 1997	2002	
County	87% (±11%)	89% (±12%)	↑ 2% points
Federal	92% (±4%)	96% (±7%)	↑ 4% points
Industrial	91% (±6%)	95% (±4%)	↑ 4% points
NIPF	82% (±7%)	81% (±9%)	↓ 1% points
State	87% (±13%)	100% (±0%)	↑ 13% points
Tribal	97% (±2%)	93% (±7%)	↓ 4% points

Table 1: Comparison of correct application where needed by landowner category for 1995-1997 and 2002 studies.

BMP Application by BMP Category

Figure 10 illustrates the frequencies of correct application where needed for each BMP category. BMP categories are groups of BMPs with similar characteristics. Frequency of correct application was significantly higher for *Fuels, Lubricants, Wastes and Spills* and for *Timber Harvesting* ($p \leq 0.05$). There were no significant differences among other categories.

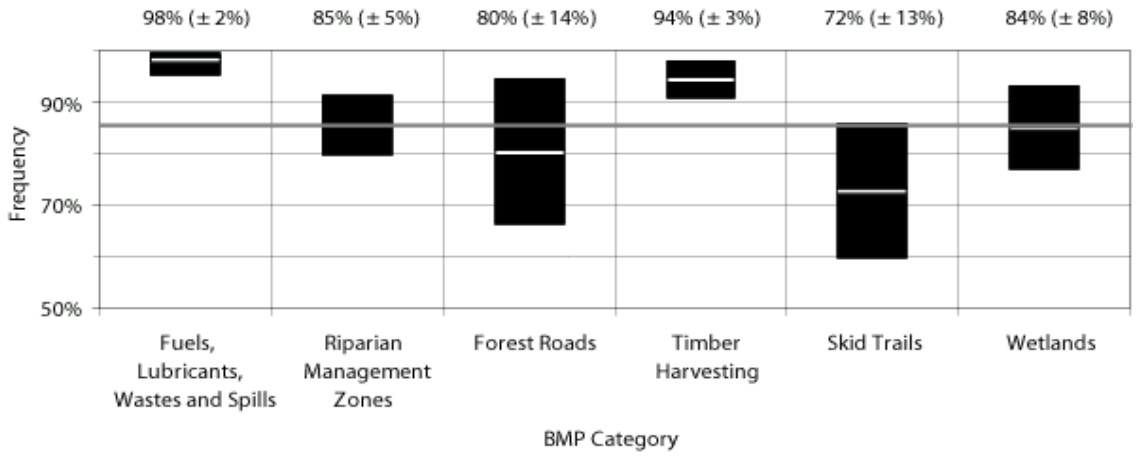

Figure 10: Frequencies of correct application of BMPs where needed by the six BMP categories, with 95% confidence intervals. The bold horizontal line represents mean application (86%) across all BMP categories. Data presented represents timber sales where harvesting occurred on a wetland or within 200 feet of a lake or stream.

Changes in BMP Application by BMP Category

Estimates for correct application by BMP category are compared in Table 2. Generally, correct application increased across all BMP categories except *Wetlands*. Statistically, all estimates are the same ($p>0.05$). Estimates for *Skid Trails* and *Timber Harvesting* cannot be compared because a number of the BMPs from *Timber Harvesting* were re-categorized into *Skid Trails* since 1997.

Landowner Category	Frequency of correct application where needed, with 95% confidence interval (1/2 width)		Difference
	1995 - 1997	2002	
Fuels, Lubricants, Wastes and Spills	92% (± 5%)	98% (± 2%)	↑ 6% points
Riparian Management Zones	82% (± 5%)	85% (± 5%)	↑ 3% points
Forest Roads	78% (± 11%)	80% (± 4%)	↑ 2% points
Skid Trails	none	72% (± 13%)	Not comparable
Timber Harvesting	90% (± 4%)	94% (± 3%)	Not comparable
Wetlands	87% (± 6%)	84% (± 8%)	↓ 3% points

Table 2: Comparison of correct application where needed by BMP category for 1995-1997 and 2002 studies.

BMP Application Ratings: Tax Law and Non-Tax Law Participants

The frequencies of correct application for tax law and non-tax law NIPF landowners were compared. NIPF landowners enrolled in Managed Forest Law (MFL) or Forest Crop Law (FCL) were considered a tax law participant. This information was obtained from the DNR tax law database. As illustrated in Figure 11, BMPs applied on tax law participant ownership were applied correctly more often than on non-tax law participant ownership: 91% (± 4%) and 73% (± 14%), respectively. Sample sizes for tax law and non-tax participants were 29 and 31, respectively.

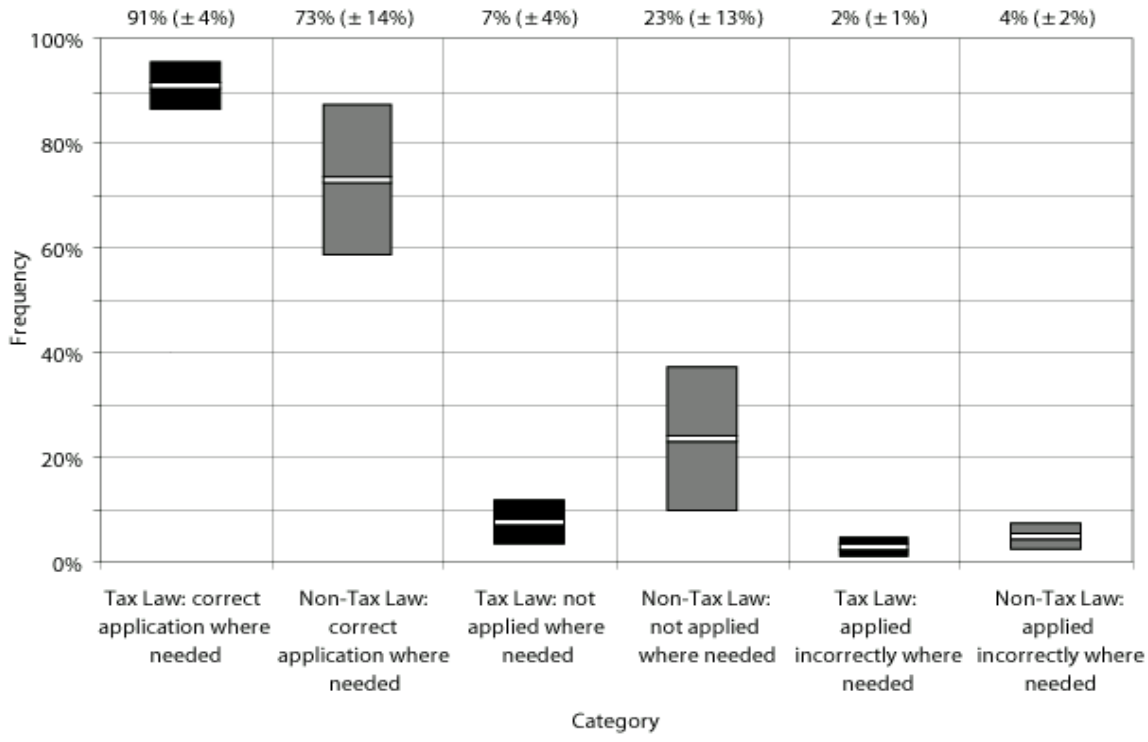

Figure 11: Frequencies of correct application of BMPs where needed for tax law and non-tax law participants, with 95% confidence intervals. Data presented represents NIPF timber sales where harvesting occurred on a wetland or within 200 feet of a lake or stream.

BMP Effectiveness

For each of the three application ratings used when a BMP was needed, a corresponding effectiveness rating was marked on the monitoring worksheet. Effectiveness ratings identified impacts on water quality.

Effectiveness ratings were "snap shot" or point-in-time qualitative evaluations, meaning that the monitoring teams used their professional judgment from a visual inspection and no measurements were taken. Conditions that monitoring teams looked for included: evidence of erosion sediment deposition; signs of fuels and lubricants on the soil; rutting; excessive removal of timber next to streams and lakes; and the layout of roads, skid trails and landings. To help in the timber sale evaluations, loggers, foresters and landowners were encouraged to explain to the team the sale history and describe situations where BMPs may have been modified for site-specific conditions.

Effectiveness Ratings Defined

Understanding effectiveness ratings may be difficult. For better understanding, two approaches are presented within this section: definitions and samples from monitoring worksheets. The effectiveness ratings are defined as follows:

- *Short-term*: Impact lasting one year or less from completion of activity; no more than one runoff season.
- *Long-term*: Impact lasting more than one year from completion of harvesting activity.
- *Minor*: Slight adverse impact on the water resource.
- *Major*: Significant adverse impact on the water resource.

Tables 2 and 3 contain sample comments documented on monitoring worksheets. The samples in these tables illustrate the definitions of *major long-term* and *minor long-term*:

BMP	Comments where *minor long-term impacts* were noted
B3	No RMZ on small navigable perennial creek and slash in stream.
B3	Significant tree tops left in navigable perennial stream.
B4	One site where soil exposure was heavy out of three streams.
B4	More channeled flow caused by rutting.
B6	Basal area is lower than 60 square feet.
C15	Small culvert was not filled high enough - water was being dumped off at culvert.

Table 2: Comments and corresponding BMPs for effectiveness ratings marked as minor long-term impact.

BMP	Comments where *major long-term impacts* were noted
B6	Area was clear-cut to stream.
C1	Wetland filled with sediment and drainage blocked by road.
C12	Totally destroyed the stream channel - no banks exist anymore.
C27A	Road is a deep trench.
C3	Straight up hill with road like a trench, funneling sediment into stream.
C47	Road continues to erode into wetland.
D15	Channel completely destroyed and turned to mud hole.
D15	Slash was placed on non-navigable part of stream and left in causing sediment back up and disrupting migration.
D34	Ford was constructed by placing tree tops perpendicular to stream.

Table 3: Comments and corresponding BMPs for effectiveness ratings marked as major long-term impact.

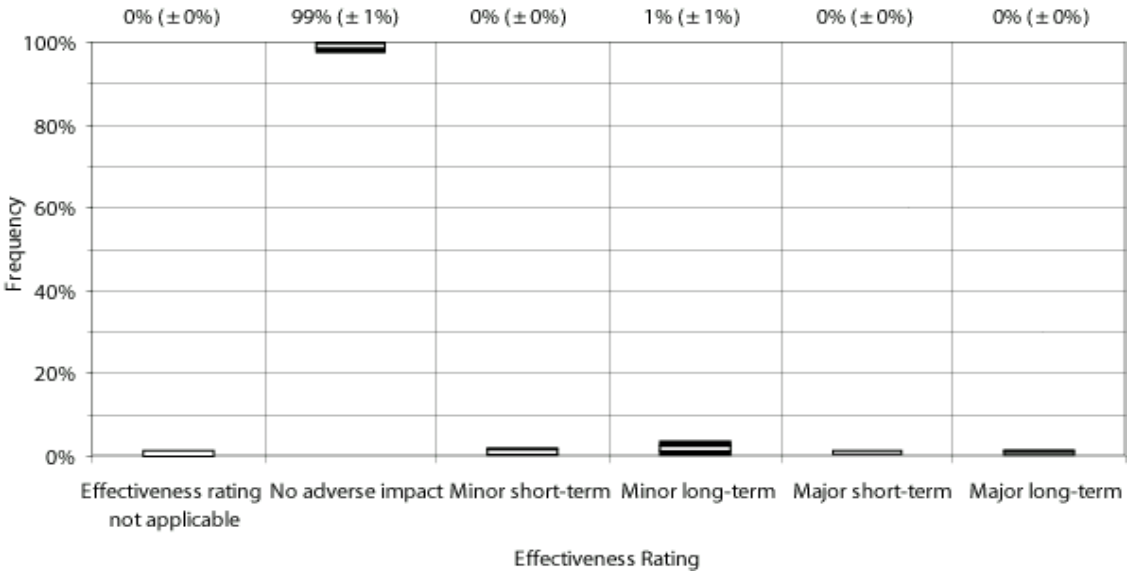

Figure 12: Frequencies of effectiveness where BMPs were applied, with 95% confidence intervals. Data presented represents timber sales where harvesting occurred on a wetland or within 200 feet of a lake or stream.

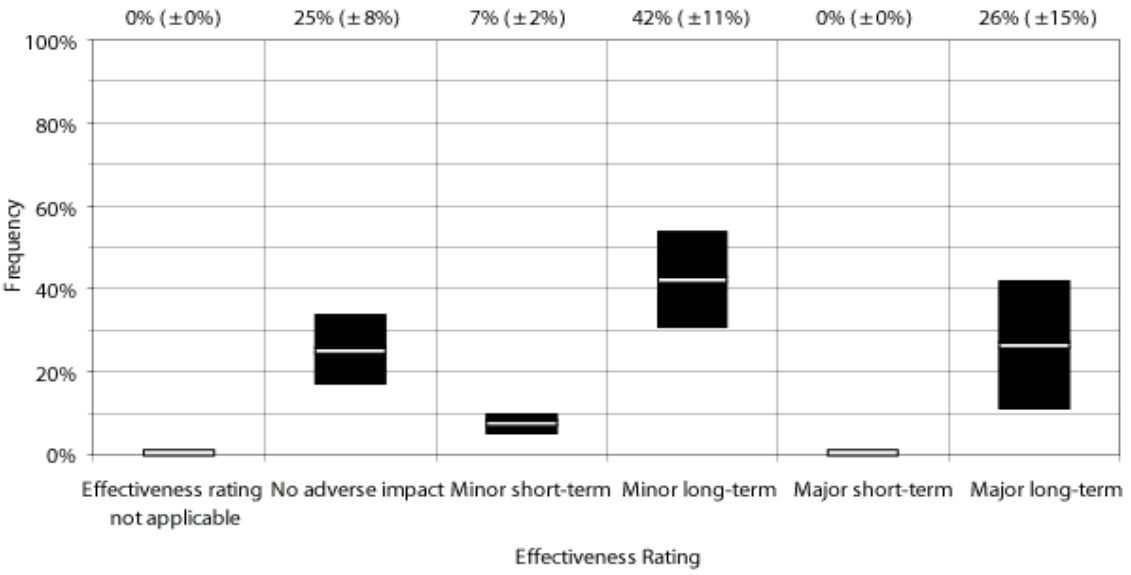

Figure 13: Frequencies of effectiveness where BMPs were not applied, with 95% confidence intervals. Data presented represents timber sales where harvesting occurred on a wetland or within 200 feet of a lake or stream.

Impacts to Water Quality When BMPs Were Applied Where Needed

Figure 12 illustrates the frequencies of effectiveness ratings, when BMPs were applied where needed. On average, 99% (± 1%) of the time *no adverse impact* was recorded. This is consistent with the 1995-1997 findings.

Impacts to Water Quality When BMPs Were Not Applied Where Needed

Figure 13 illustrates the frequencies of effectiveness ratings, when BMPs were not applied where needed. On average, 25% (± 16%) of BMPs not applied resulted in *no adverse impact*, compared to 37% from 1995-1997. The frequency of *major long-term impact* increased from 4% to 26% (± 29%). However, overall frequencies for *minor impact* and *major impact* were 49% (± 12%) and 26% (± 15%), respectively. Incorrect application and no application resulted in a minor impact more often than a major, even though the frequency of *major long-term impact* increased.

Changes in Impact Rating, Severity, and Duration

Table 4 is a comparison of the frequencies for each type of impact, 1995-1997 verses 2002 studies. Overall, adverse impacts have increased 12 percentage-points. The majority of this increase was attributed to responses marked as *major long-term impact*. No confidence intervals exist for the 1995-1997 estimates, so this information has been omitted. It is acceptable to assume most of these estimates are statistically indifferent ($p < 0.05$).

Impact	Frequency of not applied where needed		Difference
	1995 - 1997	**2002**	
Adverse	63%	75%	↑ 12% points
No adverse	37%	25%	↓ 12% points
Minor short-term	15%	7%	↓ 8% points
Minor long-term	43%	42%	↓ 1% point
Major short-term	1%	0%	↓ 1% point
Major long-term	4%	26%	↑ 22% points
Minor	58%	49%	↓ 11% points
Major	5%	26%	↑ 21% points
Short-term	16%	7%	↓ 9% points
Long-term	47%	68%	↑ 21% points

Table 4: Comparison of impact severity, duration and rating when BMPs were not applied for 1995-1997 and 2002 studies.

Impacts When BMPs Were Not Applied Where Needed

Table 5 lists the ten BMPs most often not applied where needed and their impact on water quality, as rated on the monitoring worksheets. In many situations where BMPs listed in Table 6 were not applied where needed, monitoring teams observed an impact on water quality.

BMPs B5, B6, B8 and B9 were listed as top ten BMPs most often *not applied where needed* in the 1995-1997 report. This trend suggests that these BMPs have been consistently not applied, and that future BMP education and training should focus more on these four BMPs.

BMP	Percent of times BMP was not applied where needed	When BMP was not applied where needed, number of times there was:				
		No adverse impact	Minor short-term impact	Minor long-term impact	Major short-term impact	Major long-term impact
C52 - Shape road surfaces periodically to maintain proper surface drainage. Fill in ruts and holes with gravel or compacted fill as soon as possible.	24% (6/25)	2	0	2	0	2
♦B5 - Do not operate wheeled or tracked harvesting equipment within 50 feet of the ordinary high-water mark except on roads or at stream crossings.	24% (11/46)	6	1	4	0	0
♦B8 - Harvesting intervals should be no more frequent than every 10 years.	23% (10/44)	45	1	3	0	1
B3 - Do not move slash into or pile slash within the RMZ. Keep slash out of lakes and stream channels and away from areas where it may be swept into the water.	21% (12/58)	4	1	7	0	0
E12 - Cease equipment operations when rutting becomes excessive.	21% (7/34)	0	1	5	0	1
♦B9 - Develop trees 12 inches DBH and larger.	19% (8/42)	3	1	3	0	1
C3 - Select road locations that allow for drainage away from the road.	17% (4/23)	2	0	1	0	1
♦B6 - Use selective harvesting and promote long-lived tree species appropriate to the site: i.e. sugar/red maple, oaks, white/black ash, hemlock, white/red pine and white cedar.	16% (7/43)	2	1	3	0	1
D3 - Avoid operating equipment where excessive soil compaction and rutting occurs.	9% (7/76)	1	1	4	0	1
D4 - Do not pile slash into drainage areas where runoff may wash slash into streams, lakes, or wetlands.	7% (5/69)	1	1	3	0	0

Table 5: Top ten BMPs most often not applied where needed. *Formulated by removing outliers (0/0 and 1/1) and then BMPs below X/21 (mean - outliers). Data presented represents timber sales where harvesting occurred on a wetland or within 200 feet of a lake or stream. A ♦ indicates a BMP was listed as a top ten most often* not applied where needed *BMP 1995-1997.*

BMP Application, Effectiveness and Statistical Significance

The previous two sections of this report documented many estimates on BMP application and effectiveness. For the purpose of clarity, statistical significance for each type of estimate is discussed. Despite the statistical insignificance of some estimates within this report, they were included to meet the monitoring objectives. These values were estimated as best as possible, given the resources of the study.

Estimates for BMP Application

The extent to which BMPs were applied throughout Wisconsin was examined in section one, BMP Application. Specifically, overall application, application by landowner category and application by BMP category were examined. Estimates for overall application are statistically valid, with respect to sample size. However, the comparison of overall application by year, the possible increasing trend of overall application over time and the possible trend in variance over time are not statistically valid, because p-values are greater than 0.05.

The only landowner category with a substantial sample size was NIPF ($n=60$). Sample sizes for county ($n=6$), state ($n=2$), tribal ($n=6$), and federal ($n=3$) landowner categories are small enough that results for these categories should be interpreted cautiously. Estimates by BMP category, for *correct application* and for *no application*, and by tax law category are all based on large sample sizes so that large sample approximations for confidence intervals are valid.".

Estimates for BMP Effectiveness

The effectiveness of BMPs when applied and when they failed to be applied was the topic of the second section, BMP Effectiveness. Estimates for the frequencies of impacts when BMPs were *not applied* are based on 2% of all responses. This estimate is valid, given the 85-sale sample size, however confidence intervals are relatively wide. The estimate for the frequencies of impacts when BMPs *were applied* is statistically valid.

Focusing on failure of application, impact severity and duration were discussed. BMPs that were frequent in failure of application were listed and repeats from the 1995-1997 report were noted. These are merely observations of the1995-1997 results and the results presented in this document

Other Components of the Monitoring Worksheet

Second to BMP application and effectiveness, other information was collected on the monitoring worksheet. These additional components documented important site attributes, overall judgment ratings and landowner characteristics.

Supplemental Questions

Supplemental questions were both objective and subjective. The information collected from these questions served to document such variables as apparent management, weather conditions and physical site characteristics. Although the data collected was not statistically valid, the following list summarizes some of the monitoring teams' responses:

- The average slope of monitored timber sales was 9%.
- The acreage of an average monitored timber sale was 40.
- 28% of timber sales monitored were classified as a clearcut. All other silvicultural systems were classified less than 28%.
- 34% of the timber sales visited were classified as gently rolling. This classification accounted for the greatest percentage.
- 54% of the timber sales monitor were classified as having low erosion potential and 9% were classified as high.
- Soil texture on 25% of the sites was classified as loamy sand. All other types of soil texture were classified less than 25%.

Team members also recorded the types of water features that were present on each site. The predominant water feature for each site is represented in Figure 14. Every region is diverse in water features. Therefore, a number of BMPs may be applicable in any particular region.

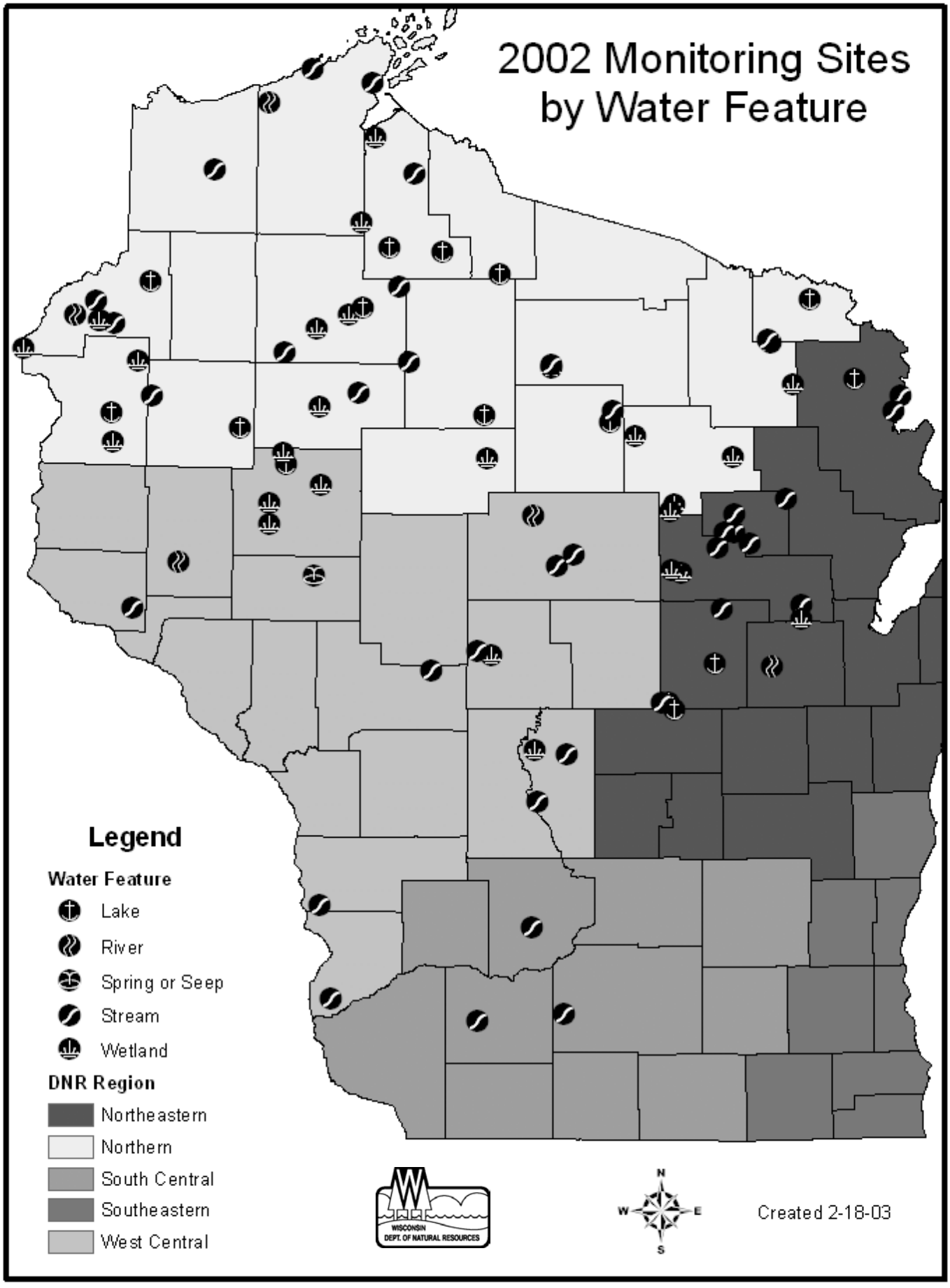

Figure 14: Locations of the 2002 monitoring sites by water feature type.

Professional Judgment Ratings

Each team suggested professional judgment ratings for every monitoring site. The responses were used as measures of overall rating, useful for describing monitoring outcome to participating landowners. Figure 15 illustrates the number of ratings recorded for each professional judgment category. Most responses were greater than four, or *good* to *excellent*. See Appendix C for definitions of each professional judgment rating.

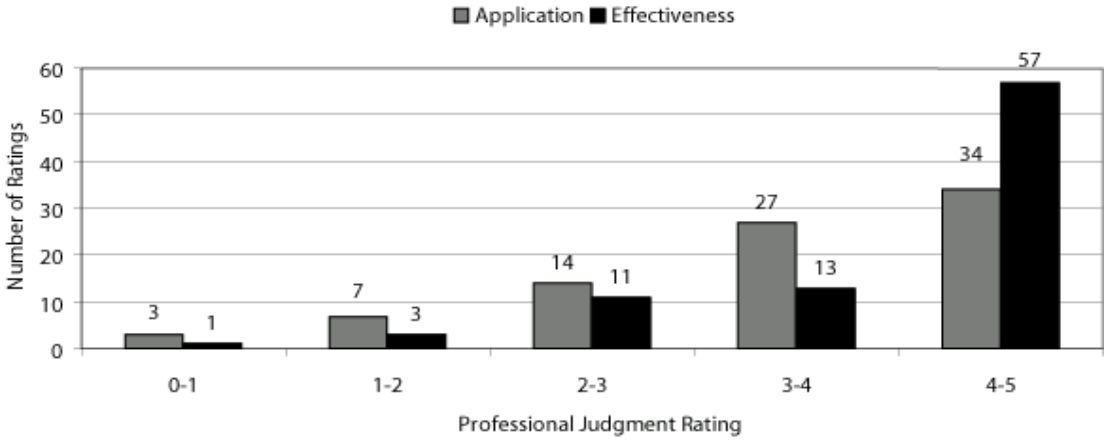

Figure 15: Number of total ratings for each professional judgment category. Data presented represents timber sales on a wetland or within 200 feet of a lake or stream.

Landowner Survey

The landowner survey was supplemental, and was only conducted with NIPF landowners. Generally, DNR staff conducted the survey in person during monitoring or soon after monitoring, via the telephone. Information on timber sale contract, foresters, landowner objectives, satisfaction and BMP education was collected from the survey.

Independent of BMP application and effectiveness, some interesting observations were made:

- 24% of NIPF landowners were familiar with BMPs before timber harvesting.
- The three main reasons for timber harvesting were mature trees, timber stand improvement and tax law requirement.
- 76% of the sales included a written timber sale contract.
- 71% used a forester to set up the sale.
- On a 1-10 scale, the average overall rating of timber sale satisfaction was 7.4.

Overall, foresters aided a large percent of NIPF landowners. The cooperation between landowners, loggers and foresters will help to ensure that BMPs are implemented, protecting water quality. Perhaps an undesirable percentage of NIPF landowners were aware of BMPs before harvesting. This may indicate that more education is needed within the NIPF landowner category.

Chapter Four: Costs

Costs are an important consideration when determining the future direction of BMP monitoring in Wisconsin. Although BMP monitoring is beneficial, associated costs must be analyzed. Costs associated with the 2002 BMP monitoring effort can be broken down into five categories:

- Aerial surveys
- Cutting notices
- BMP workshop
- NIPF field checks
- Monitoring teams

Aerial Surveys

The distribution of sites monitored during 1995-1997 was a concern in 2002. While maintaining an unbiased and random selection of timber sales was critical, we hoped to find eligible sales from a wide variety of Wisconsin counties. We especially hoped to monitor some sales in the southwest corner of the state. Obviously, this area does not represent the majority of logging activities in Wisconsin, but several factors result in the southwestern counties not being well represented in BMP monitoring. For example, property owners from this area have a lower compliance rate of filing a Chapter 26 cutting notice with their particular county. Since the list that we used to randomize timber sales from 2001-2002 was based upon cutting notices, among other methods, sales in the southwestern counties were less likely to be selected.

The BMP Advisory Committee encouraged that a means to offset the lower compliance rates of filing cutting notices in southwestern Wisconsin would be to use aerial surveys in that area of the state (during 2000-2001, DNR staff used aerial surveys for locating timber sales in the Kickapoo River Watershed in Southwest Wisconsin and achieved considerable success using this method). In the spring of 2002, aerial surveys were conducted over 11 randomly selected counties.

Between the actual aerial surveys and the subsequent compiling of data, approximately 250 hours were spent on aerial surveys. The cost of the aerial surveys was about $5,500, mostly for the use of the DNR airplane and pilot.

Cutting Notices

Chapter 26 cutting notices were a valuable tool in identifying statewide timber sales in 2001-2002. Although every county has a somewhat different method for filing the notices, it is required for property owners to notify the county of timber harvesting intentions. Individual counties throughout the state were contacted in the spring of 2002. For most counties, copies of the cutting notices from this time period were available for a nominal fee. Obviously, charges for the cutting notices varied between counties because of frequency of timber sales and differences in fees. The charges for obtaining the notices were relatively inexpensive and provided us with a large pool of potential monitoring sites.

Approximately 200 hours were spent contacting counties and consolidating the cutting notices into a useable pool of sales. The total cost of obtaining the copies from the various counties was $313.

BMP Workshop

In July of 2002, a BMP Workshop was held at the University of Wisconsin Stevens Point. The main purpose of the workshop was to educate and train those people that would be members of a 2002 monitoring team. The two-day event was held to provide consistency between teams and allow for some questions to be answered before teams began their monitoring later in the fall. The workshop was necessary because many of the team members had not previously participated in BMP monitoring. Future workshops may or may not be necessary as more past members return for monitoring.

The number of hours accumulated in planning and attending the workshop by DNR staff and external partners was estimated to be 1,100. Costs included lodging, conference rooms, meals, and parking at the University, and travel vouchers and stipends for the team members. The estimated total cost of the workshop was $5,510[1].

NIPF Field Checks

The most significant cost involved with the 2002 BMP monitoring effort came from field checks. This refers to the physical checking of timber sales for monitoring eligibility. More specifically, field checking was necessary for the non-industrial private landowner (NIPF) category. To locate the 60 statewide NIPF sales that were later monitored by teams, nearly 350 NIPF sales were field checked.

Central office staff conducted the majority of the field checks. DNR field staff was later asked to assist in the effort. In some cases, he/she would physically check the sales from his/her particular county. In other cases, he/she would pre-screen the list of sales from the county, eliminating those sales that absolutely do not qualify, and send that shortened list back to central office for subsequent field checking. Both methods helped the field checking effort tremendously. Without the assistance from field staff, sites would not have been ready for teams to monitor in late September and October.

The field checking for eligible sales was a massive undertaking. Several hundred hours were spent by central office and field staff traveling the state and physically checking sales from our random statewide list. It is estimated that nearly 1800 hours was spent in this effort. Of that total, central office staff spent about 1,600 hours in the field throughout August, September and October. Approximately $8,260[2] was used for vehicle costs, meals, lodging and other miscellaneous items while performing field checks.

Monitoring Teams

The fifth category associated with costs was the actual monitoring conducted by teams. There were eight teams consisting of a total of 46 participants. The costs associated with this category include vehicle use, meals, lodging and stipends for team members accumulated while in the field conducting the monitoring. The cost for the monitoring teams was approximately $7,330. In addition, nearly 2,000 hours were devoted by the monitoring teams. This estimate includes work done by central office staff, the eight teams leaders prior to fieldwork (e.g. contacting landowners and team members, creating maps, etc.) and the other team members.

Total Costs

Excluding Salary and Fringe

Table 6 summarizes the estimated costs associated with the 2002 statewide BMP monitoring effort. The table accounts for the five categories of costs discussed earlier. Essentially, these costs are for material goods. Table 6 *does not* include a major component of the costs: salary and fringe benefits of DNR staff and the opportunity costs for those partners involved.

[1] Includes lodging, rooms, dining, parking as UWSP, water, soda, ice, repellent, bus transportation and travel vouchers.
[2] DOA pool vehicle use, meals, cell phones, batteries and lodging.

	Hours	Expenses
1. Aerial Flights	250	$5,500.00
2. Cutting Notices	200	$312.89
3. BMP Workshop	1100	$5,509.45
4. NIPF Field Checks	780	$8,255.60
5. Monitoring Teams	1962	$7,328.46
Totals	**4292**	**$26,906.40**
per site	**50.5**	**$316.55**

Table 6: Estimated costs for the 2002 statewide monitoring effort, not including a sixth category of salary and fringe benefits or in-kind costs.

As Table 7 demonstrates, a total of $26,906 was spent on the BMP monitoring effort. It is important to remember that this estimate is for material costs only (e.g. lodging, meals, workshops, copies of cutting notices, etc.) and does not include salary. The contribution of staff time is reflected as part of the 4,292 hours devoted toward the 2002 monitoring. Perhaps more meaningful figures for comparison are the average cost and hours spent for each monitored sale. Since 85 total sales were monitored, the cost was approximately $317 with about 51 hours devoted toward each site.

Including Salary and Fringe

Table 7 reflects the costs associated with the 2002 monitoring effort including salary and fringe benefits of DNR staff and the opportunity costs for external partners involved. Unlike the previous table, category five of the table below includes the expenses of the partners involved in the 2002 monitoring. Notice that the cost for this particular category increased drastically from $8,256 to $67,852. It is critical to understand that the $8,256 figure more closely represents the out-of-pocket costs for the DNR. The latter and larger figure accounts for opportunity costs, or potential income that external partners lost for participating in the BMP effort. Category six (salary and fringe) in the table below was not included in the previous table. This $85,129 figure represents the salary and fringe benefits of DNR staff only.

	Hours	Expenses
1. Aerial Flights	250	$5,500.00
2. Cutting Notices	200	$312.89
3. BMP Workshop	1,100	$5,509.45
4. NIPF Field Checks	780	$8,255.60
5. Monitoring Teams	1,962	$67,852.46
6. Salary and Fringe	--	$85,129.08
Totals	**4292**	**$172,559.48**
per site	**50.5**	**$2,030.11**

Table 7: Estimated costs for the 2002 statewide monitoring effort including in-kind costs as well as salary and fringe benefits.

The estimates of total costs associated with the monitoring in the two tables above are extremely different. The first, Table 6, details the cost of material goods and is a better indication of actual DNR costs. The second, Table 7, includes the salary and fringe benefit estimates for the participants, both DNR and external, in the 2002 BMP monitoring effort.

Chapter Five: Conclusions

The results of the 2002 BMP monitoring show that Wisconsin's forestry BMP program is as successful or more successful than when monitoring was first conducted during 1995-1997. Monitoring yielded comparable results, useful for decision making by the BMP Advisory Committee and others.

Monitoring Objectives Concluded

Objective One

Forestry BMPs are being applied correctly where needed 86% of the time. This estimate is very similar to the 1995-1997 study and demonstrates that BMPs continue to be embraced and applied at a relatively high rate. In addition, trends in overall application and variance forecast that Wisconsin's voluntary, non-regulatory approach is growing in success.

Although the correct application rate for NIPF has decreased one percent since 1995-1997, statistically it has not changed. Sample sizes for other landowner categories were too small to infer accurate estimates on correct application. Despite small sample size, the frequencies or correct applications for other landowner categories appear to have increased.

Despite statistical indifference, correct application by BMP category was generally better than the 1995-1997 study. NIPF ownership of tax law participants scored better than ownership of non-tax law participants with respect to the correct application of BMPs.

Objective Two

It is difficult to determine, from the quality of the data collected, if BMP education and training workshops have been effective. For NIPF, post-1997 BMP education and training have not changed the correct application rate. Small sample sizes for other landowner categories make determining effectiveness difficult. BMPs B5, B6, B8, and B9 were listed as top ten BMPs not applied, two studies running.

Objective Three

Generally, more long-term impacts were recorded this study than the previous study. The frequency of responses for *Major long-term impacts* was the only effectiveness rating that increased this study. The frequencies of responses for all other effectiveness ratings decreased.

Generalities

Undoubtedly, the interaction of monitoring team members with landowners, loggers, and foresters has facilitated education. Groups of people involved with monitoring, both external and internal, have gained a better understanding of the BMP guidelines. Each year of BMP monitoring and each training session exposes additional people to the program. Undoubtedly, the need for larger, more statistically significant sample sizes is great. Estimates for landowner categories other than NIPF are unsatisfactory, and need improvement.

Monitoring yielded important information, invaluable for monitoring water quality – both today and tomorrow. Although costs may appear high, it is relatively small compared to that of a regulatory program.

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Appendix A: Process for Updating BMPs

Process for Updating BMPs

The Division of Forestry, in partnership with the BMP Advisory Committee, is responsible for conducting and completing a BMP updating process.

Step 1. Solicit input from practitioners, landowners, and other interested groups (foresters, loggers, landmanagers, etc.) on BMPs that need updating. The BMP Advisory Committee will solicit input from represented constituencies. Suggest comments specify why the BMP is a concern and in need of updating. (Solicit input via technical forums, training sessions, letters to individuals, etc.)

Step 2. Summarize input; request experts for a review of existing BMPs; provide summary of input gathered in Step 1 to experts to focus review. Request experts to conduct a review to specifically identify:
a.) Potential training and education needs.
b.) Potential research needs.
c.) BMPs to explore further on the need to update, modify or improve.
Experts produce reports and/or analysis of review findings and recommend priority needs.

Step 3. BMP Advisory Committee evaluates experts' recommendations and confirms the following:
- ✓ Potential training and education needs.
- ✓ Potential research needs.
- ✓ BMPs to explore further on the need to update, modify or improve.

Step 4. For those BMPs that are identified in Step 3.c. above, initiate the process to update, modify, or improve following public input and further analysis:
- Provide general public information of BMP(s) proposed for revision/update.
- Assemble team of experts and practitioners and have team draft the updates. (Experts to be drawn from sources such as SAF, University, USFS, Forest industry, environmental groups, loggers, land managing agencies, etc.)
- Public review and comment.
- Consideration of public and expert input.
- BMP Advisory Committee develops final report and recommendations to Chief State Forester.
- Chief State Forester makes decision.
- Formalize updates.

Step 5. Implement all BMPs (including those newly revised) and incorporate performance analysis into monitoring effort to determine why or why not BMPs are being implemented. Note: ongoing quantitative and qualitative analysis.

Appendix B: 2002 Monitoring Team Members

Key:

TL: team leader	*L: logging*
S: soils	*FM: forest management*
WQ: water quality	*EC: environmental/conservation*

Northern Team

Monitoring Dates: ***Sept 30, Oct 1, 2, 3***

TL: Glen Weigenstein	DNR Forester
EC: Mary Platner	Wisconsin Association of Lakes
L: Norb Schmidt	Independent Logger
FM: Dean Pelkey	PCA
S: Teri Hyer	USFS
WQ: Butch Lobermeier	Price County LCD

Northwest Team

Monitoring Dates: ***Oct 21, 22***

TL: Terryl Buchman	DNR Forester
S: David Hoppe	USFS
FM: Steve Kariainen	LP
EC: Jim Kissinger	Wisconsin Assoc. of Lakes
WQ: Rich Wiest	USFS
L: Max Ericson	Ericson Logging

Northwest Team

Monitoring Dates: ***Sept 30, Oct 1, 2***

TL: Deb Sigmund	U.S. Forest Services
EC: Roger Reas	Ducks Unlimited
FM: Frank Zumpf	Zumpf Forestry Consulting
L: Max Erickson	Ericson Logging
S: Randy Gilbertson	NRCS
WQ: Stacy Dehne	DATCP

Northeast Team

Monitoring Dates: ***Oct 21, 22, 23***

TL: Mike Schuessler	DNR Tribal Liaison Forester
WQ: Greg Rebman	NRCS
L: Dave Stoiber	IP
S: Dennis Fritz	Outagamies County LCD
FM: Tim Tollefson	Stora Enso
EC: Glenn Charlson	WWOA

Eastern Team

Monitoring Dates: ***Oct 7, 8, Nov 11***

TL: Ron Jones	DNR Forester
S: Tom Jacobs	LP
WQ: Ken Denow	DNR SE Region
L: Aaron Burmeister	Burmeister Logging
FM: Luke Skarlupka	IP
EC: Virgil Kopitske	WWOA

Southwest Team

Monitoring Dates: ***Oct 21, 22, 23***

TL: Brooke Ludwig	DNR Forester
EC: Pat Cannon	River Alliance
FM: Tim Nicklaus	Webster Industries
L: Nic Klapatanskas	Klapatanskas Forest Products
S: Matt Otto	NRCS
WQ: Eric Forward	Citizen

Northern Team

Monitoring Dates: ***Oct 15, 16, 23***

TL: Colleen Matula	DNR Forest Ecologist
FM: Greg Lake	IP
L: Ed Brandis	Timber Producers Association
S: T.J. Huffman	NRCS
WQ: Barb Schieffer	Florence County LCD
EC: Tracey Leddes	Bad River Watershed Assoc.

Southern Team

Monitoring Dates: ***Oct 28, 29, 30***

TL: Steve Holaday	DNR Forester
EC: Gigi LaBudde	Community For. Research
FM: Joe Kies	Domtar
L: Jim Bednar	Hanson & Leja Lumber Co.
S: Eunice Padley	DNR Division of Forestry
WQ: Carmen Wagner	DNR Division of Water

Appendix C: Eligibility Criteria for 2002 Timber Sale Monitoring

Eligibility Criteria for 2002 Timber Sale Monitoring

Below are the criteria that should be used for determining if a timber sale is eligible for monitoring in 2002. To be eligible, the answer for each question below needs to be "yes".

1. Is part or all of the timber sale on a wetland or within 200 feet of a lake or stream?
2. Was harvesting on the timber sale completed in 2001 or 2002?
3. Does the landowner give permission for a monitoring team to visit the timber sale on their property (DNR staff will make the landowner contacts and ask for permission)?

County _____ Sale # _____ Random #_____

Landowner _____ Telephone (____)_____

Address_____

_____

Town of _____ Year and months of harvest_____

Logger _____ Forester_____

Water features present: ☐ Lake ☐ Navigable stream ☐ Wetlands

☐ River ☐ Non-navigable stream ☐ Spring

Legal Description _____1/4_____1/4, Section_____, T_____N, R_____East West

Does the landowner reside on this property? Yes No

Does the landowner want to go with monitoring team? Yes No

Access to sale from:

_____

Notes:

Appendix D: 2002 BMP Monitoring Worksheet and Landowner Survey

Audit Worksheet and Supplemental Questions for Wisconsin's Forestry Best Management Practices for Water Quality

Objectives of BMP Monitoring

1) Determine the extent to which BMPs were applied on the selected sites.

2) Determine the effectiveness of properly applied BMPs in protecting water quality on the selected sites.

3) Determine the effects of not applying BMPs where needed on the selected sites.

4) Examine the attitudes and concerns of private non-industrial landowners, concerning their timber sale, with emphasis on BMPs and riparian management (where applicable).

5) Obtain descriptive information about RMZs and buffer strips (where present) with respect to size, vegetative composition, and past use.

The results of these objectives from BMP Monitoring will be used to:

* Identify trends
* Identify where modifications may be needed in the BMP field manual
* Identify research and information needs
* Educate landowner, loggers and foresters involved in the sites that are monitored
* Identify special education and training needs for private non-industrial landowners
* Compare and contrast with other regions of the state

Timber Sale Number: _____ Audit Date: _____

Landowner: _____ County: _____

Audit Weather Conditions: _____

GPS Track Name: _____

Monitoring Team Members Auditing the Site:

Name:	Affiliation:

Non-Team Members at the Site:

APPLICATION 0 -- BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	EFFECTIVENESS 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term

BEST MANAGEMENT PRACTICES	APPLICATION	EFFECTIVENESS	COMMENTS/IMPACT
A. Fuels, Lubricants, Waste and Spills			
Fuels, Lubricants, and Waste (p. 13)			
1. Designate specific areas for equipment maintenance and fueling. Locate these areas on level terrain, a minimum of 100 feet from all streams and lakes.			
2. Collect all waste lubricants, containers, and trash (i.e. grease cartridges).			
B. Riparian Management Zones			
BMPs Common to All Three RMZ Categories (p. 18)			
1. Construct or use existing roads outside the RMZ, unless necessary for stream crossings.			
2. Construct or use existing landings outside the RMZ.			
3. Do not move slash into or pile slash within the RMZ. Keep slash out of lakes and stream channels and away from areas where it may be swept into the water.			
4. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.			
BMPs for Lakes and Navigable Perennial Streams (100' wide RMZ) (p. 19)			
5. Do not operate wheeled or tracked harvesting equipment within 50 feet of the ordinary high-water mark except on roads or at stream crossings.			
6. Use selective harvesting and promote long-lived tree species appropriate to the site: i.e. sugar/red maple, oaks, white/black ash, hemlock, white/red pine & white cedar.			
7. Harvesting intervals should be no more frequent than every 10 years.			
8. Do not reduce basal area below 60 ft2 per acre in trees 5-inches DBH and larger, evenly distributed.			
9. Develop trees 12-inches DBH and larger.			

APPLICATION 0 -- BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	EFFECTIVENESS 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term

BEST MANAGEMENT PRACTICES	APPLICATION	EFFECTIVENESS	COMMENTS/IMPACT
B. Riparian Management Zones			
BMPs for Navigable Intermittent Streams (35' wide RMZ) (p. 20)			
10. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high-water mark only when the ground is frozen or dry.			
11. Use selective harvesting and promote long-lived tree species appropriate to the site.			
12. Harvesting intervals should be no more frequent than every 10 years.			
13. Do not reduce basal area below 60 ft2 per acre in trees 5-inches DBH and larger, evenly distributed.			
BMPs for Non-Navigable Streams (35' wide RMZ) (p. 20)			
14. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high-water mark only when the ground is frozen or dry.			

Management During Harvest:

1. Was the RMZ widened on steep slopes or on areas of highly erodible soils?
   ___ yes ___ no ___ NA

   If yes, how much? ___ (feet)

2. Did skidding occur through a stream? ___ yes ___ no

   If yes, what was the impact on the stream?

3. Type of stream: ___intermittent or ___ perennial; ___ navigable or ___ non-navigable

4. Was the skidding close to a spring(s) or seeps? ___ yes ___ no

   If yes, was there any discernible impact? ___ low ___ moderate ___ high

   Describe the spring(s) or seep(s) present:

5. Logging equipment used on the site: ___ skidder ___ forwarder ___ processor

   Did equipment have tracks? ___ yes ___ no

APPLICATION 0 – BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term impact		
BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
C. Forest Roads			
Planning, Location and Design of Forest Roads (p. 22)			
1. Use existing roads when they provide the best long- term access. Consider relocating existing roads if doing so improves access and reduces environmental impacts.			
2. Plan road systems that minimize the number, width, and length of roads to limit the total area of the site disturbed.			
3. Select road locations that allow for drainage away from the road.			
4. Where possible, locate roads on well-drained soils.			
5. If road grades > 10% are necessary, limit grade length or break the grade using drainage structures.			
6. Construct roads to follow natural contours and minimize cut and fills. Balance cut and fills to minimize the need for fill or removing excess materials.			
Stream Crossing Design and Construction (p. 23)			
General BMPs for Stream Crossings on Haul Roads (pp. 23-25)			
7. Minimize the number of stream crossings.			
8. Identify optimum stream-crossing locations: straight and narrow stream channels; low banks; firm rocky soil; keep approaches at the least gradient possible.			
9. Design, construct, and maintain stream crossings to avoid disrupting the migration/movement of aquatic life.			
10. Install stream crossings using materials that are clean, non-erodible, and non-toxic to aquatic life.			
11. Install stream-crossing structures at right angles to the stream channel.			
12. Minimize channel changes and the amount of excavation or fill needed at the crossing.			

APPLICATION 0 – BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term impact		
BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
C. Forest Roads			
Continued: General BMPs for Stream Crossings on Haul Roads (pp. 23-25)			
13. Limit construction activity in the water to periods of low or normal flow. *Check harvest dates.			
14. Keep use of equipment in the stream to a minimum.			
15. Construct a bridge or place fill directly over a culvert higher than the road approach to prevent surface road runoff from draining onto the crossing structure and into the stream.			
16. Divert road drainage into undisturbed vegetation, so that the drainage does not directly enter the stream.			
17. Stabilize approaches to bridge, culvert, and ford crossings with aggregate or other suitable material.			
18. Anchor temporary structures on one end with a cable or other device so they do not float away during high water.			
Pipe Culverts for Stream Crossings on Haul Roads (pp. 25-27)			
19. Install pipe culverts long enough so road fill does not extend beyond the ends of the culvert.			
20. Install permanent culverts that have a minimum diameter of 12 inches.			
21. Install culverts so there is no change in the stream bottom elevation. Culverts should not cause damming or pooling.			
22. Cover the top of culverts with fill to a depth of 1/3 of the pipe diameter or at least 12 inches, whichever is greater.			
23. Use riprap around the inlet of culverts. For permanent installations, use filter fabric under the riprap.			
24. Keep culverts clear and free of debris.			

APPLICATION 0 – BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term impact

BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
C. Forest Roads			
Fords for Stream Crossings on Haul Roads (p. 27)			
25. Locate fords where streambanks are low.			
26. Streambed should have a firm rock or gravel base. If not, install stabilizing material such as reinforced concrete planks, crushed rock, riprap, or rubber mats on streambeds.			
Road Construction/Reconstruction and Drainage (pp. 28 and 29)			
27. Construct roads to remove water from road surfaces:			
(a) Crowned			
(b) Outsloped			
(c) Insloped with ditches and cross drainage.			
28. Construct stable cut and fill slopes that will revegetate easily, either naturally or artificially.			
29. Do not bury debris in the road base.			
30. Surface the road with gravel where steep grades, erodible soils, or high-traffic volume make the potential for surface erosion significant.			
Drainage Structures (p.29)			
Pipe Culverts for Cross Drains on Haul Roads (pp. 30-31)			
31. Install pipe culverts to provide cross drainage on road grades at recommended intervals (Table 6-1,p. 29) immediately above steep grades, below bank seepages, and where water will run onto log landings or forest roads.			
32. Install pipe culverts long enough so road fill does not extend beyond the end of a culvert.			
33. Install pipe culverts at grades at least 2% more than the ditch grade and angled 30-45º to improve inlet efficiency (Figure 6-9).			
34. Select the size of cross-drain culverts according to the size of the road and area drained by the ditch. Permanent culverts should be 12-inch minimum diameter.			

APPLICATION 0 – BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term impact

BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
C. Forest Roads			
Continued: Pipe Culverts for Cross Drains on Haul Roads (pp. 30-31)			
35. Cover the top of the culvert with fill to a depth of 1/3 of the pipe diameter or at least 12 inches, whichever is greater.			
36. Use riprap around the inlet of culverts to prevent water from eroding and undercutting the culvert.			
Open-Top Culverts for Cross Drains on Haul Roads (p. 31)			
37. Open-top culverts should be installed only on seasonal or temporary roads.			
38. Install open-top culverts to provide cross drainage immediately above steep grades, below bank seepages, where water will run onto log landings or forest roads, and on road grades at recommended intervals (Table 6-1, p. 29).			
39. Clean open-top culverts frequently.			
Broad-Based Dips for Cross Drains on Haul Roads (p. 32)			
40. Install broad-based dips where necessary to provide cross drainage and road-surface drainage for roads with a gradient of 15% or less.			
41. Construct broad-based dips deep enough to provide adequate drainage and wide enough to allow trucks and equipment to pass safely.			
42. Place a surface of crushed stone or gravel on the dip and mound for soils and conditions where rutting may occur.			
Water Bars for Cross Drains on Haul Roads (p. 33)			
43. Install water bars where necessary to provide cross drainage and road surface drainage.			
44. Place water bars at a 30-45º angle with a cross drainage grade of 2%.			
Diversion Structures for Haul Roads (p. 33, figure on page 25)			
Install diversion ditches where necessary to divert runoff away from roads and side ditches and channel it into vegetation before the runoff enters a stream, lake or wetland.			

APPLICATION 0 – BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term impact

BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
C. Forest Roads			
Continued: Diversion Structures for Haul Roads (p. 33, figure on page 25)			
46. Construct diversion ditches so they intersect the roadside ditch at the same depth and are outsloped 1-3% (Figure 6-4).			
Soil Stabilization (p.34)			
Mulching and Seeding (p.34)			
47. Use mulch and/or seed where necessary to minimize soil erosion into streams, lakes, and wetlands.			
Sediment Control Structures (pp. 35 and 36)			
48. Install sediment control structures where necessary to slow runoff and trap sediment until vegetation is established at the sediment source:			
(a) silt fencing for sheet flow.			
(b) straw bales for sheet and channelized flow.			
49. Maintain, clean, or replace sediment-control structures until areas of exposed soil are stabilized.			
Road Maintenance (p. 37)			
Active Roads (p. 37)			
50. Clear debris from drainage structures. Place the debris where it cannot be washed back into these structures or into open water.			
51. Keep traffic to a minimum during wet periods and spring breakup.			
52. Shape road surfaces periodically to maintain proper surface drainage. Fill in ruts and holes with gravel or compacted fill as soon as possible.			
53. Remove berms along the edge of the road if they will trap water on the road.			
54. When dust control agents are used, apply them in a manner that will keep these compounds from entering lakes, streams and groundwater.			
Inactive Roads (p. 37)			
55. Remove all temporary drainage and stream crossing structures.			
56. Shape all road system surfaces to maintain proper surface drainage, if necessary.			
57. Inspect and maintain road surfaces, permanent drainage and stream-crossing structures (ditches, culverts, bridges, etc.)			

APPLICATION 0 – BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term impact

BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
D. Timber Harvesting (Uplands only, not on wetlands)			
Planning (p. 38)			
1. Limit the length and number of skid trails, and the number of landings and stream crossings.			
Harvesting (pp. 38-39)			
2. Whenever possible, winch logs from steep slopes if skidding could cause erosion that affects water quality.			
3. Avoid operating equipment where excessive soil compaction and rutting occurs.			
4. Do not pile slash into drainage areas where runoff may wash slash into streams, lakes, or wetlands.			
Landings (p. 39)			
5. Use existing landings if possible.			
6. Close existing landings in RMZs unless construction of new landings will cause greater harm to water quality than using existing landings.			
7. Locate landings outside RMZs.			
8. Locate landings on frozen ground or on firm well-drained soils with a slight slope, or on ground shaped to promote drainage.			
9. Locate residue piles (sawdust, field chipping residue, cull logs, etc.) away from drainages where runoff may wash residue into streams, lakes or wetlands.			
10. To prevent erosion and sedimentation into surface water, do the following where needed:			
(a) Fill in ruts			
(b) Seed and mulch			
(c) Install sediment control structures			

APPLICATION 0 -- BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term 5 -- Major long-term impact

BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
D. Timber Harvesting			
Skid Trails (p. 39)			
11. Where possible, keep skid trail grades < 15%. Where steep grades are unavoidable, break the grade and install drainage structures at recommended intervals (Table 6-1, p.29). Grades > 15% should not exceed 300 feet in length.			
12. To prevent erosion and sedimentation into surface water, do the following where needed:			
(a) Fill in ruts			
(b) Seed and mulch			
(c) Install sediment control structures			
General BMPs for Stream Crossings on Skid Trails (p. 23-25, 40)			
13. Minimize the number of stream crossings.			
14. Identify optimum stream-crossing locations: straight and narrow channels; low banks; firm rocky soil; keep approaches at the least gradient possible.			
15. Design, construct, and maintain stream crossings to avoid disrupting migration/movement of aquatic life.			
16. Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.			
17. Install stream-crossing structures at right angles to the stream channel.			
18. Minimize channel changes and the amount of excavation or fill needed at the crossing.			
19. Limit construction activity in the water to periods of low or normal flow. *Check harvest dates.			
20. Keep use of equipment in the stream to a minimum.			
21. Construct a bridge or place fill directly over a culvert higher than the trail approach to prevent surface road runoff from draining onto the crossing structure and into the stream.			

APPLICATION 0 -- BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term 5 -- Major long-term impact		
BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
D. Timber Harvesting			
Continued: General BMPs for Stream Crossings on Skid Trails (p. 23-25, 40)			
22. Divert trail drainage into undisturbed vegetation, so that the drainage does not directly enter the stream.			
23. Stabilize approaches to bridge, culvert, and ford crossings with aggregate or other suitable material.			
24. Anchor temporary structures on one end with a cable or other device so they do not float away during high water.			
Pipe Culverts for Stream Crossings on Skid Trials (pp.25-27)			
25. Install pipe culverts long enough so fill does not extend beyond the ends of a culvert.			
26. Install permanent culverts that have a minimum diameter of 12 inches.			
27. Install culverts so there is no change in the stream bottom elevation.			
28. Cover the top of culverts with fill to a depth of 1/3 of the pipe diameter or at least 12 inches, whichever is greater.			
29. Use riprap around the inlet of culverts. For permanent installations, use filter fabric under the riprap.			
30. Keep culverts clear and free of debris.			
Fords for Stream Crossings on Skid Trails (p. 27)			
31. Use fords for crossing dry streambeds or where fording minimizes water quality impacts.			
32. Locate fords where streambanks are low.			
33. Streambed should have a firm rock or gravel base. If not, install stabilizing material such as reinforced concrete planks, crushed rock, riprap, or rubber mats on streambeds.			

APPLICATION 0 -- BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term 5 -- Major long-term impact

BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
D. Timber Harvesting			
Continued: Fords for Stream Crossings on Skid Trails (p. 27)			
34. Pole fords must be removed immediately after use or before the upstream end becomes clogged with debris and impedes streamflow.			
E. Wetlands			
General BMPs/Planning (p. 47)			
1. Whenever practical, avoid constructing roads and landings in wetlands; otherwise use extreme caution.			
2. Forest management activities in wetlands should occur on firm ground (frozen or dry).			
NOTE: Put in the comments: (a) the slash was pushed into the wetland from an upland; or (b) trees were felled into the wetland and slash was left in the wetland - "some" slash left in a wetland is not a problem.			
3. Do not move slash from upland sites into a wetland.			
4. Keep slash out of open water.			
5. Avoid equipment maintenance and fueling in wetlands.			
Roads, Skid Trails, and Landings (p. 48)			
6. Construct upland road and trail approaches to wetlands so that surface runoff is diverted away from the road so the runoff does not enter the wetland.			
7. If landings are necessary in a wetland, build them to the minimum size required for the operation.			
8. Avoid operating equipment in areas of open water, springs or seeps.			
9. Provide for adequate cross-road drainage to minimize changes to natural surface and subsurfaceflow in the wetland.			

APPLICATION 0 -- BMP not applicable to the site 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate	**EFFECTIVENESS** 0 -- Effectiveness rating not applicable 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term 5 -- Major long-term impact

BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
E. Wetlands			
Continued: Roads, Skid Trails, and Landings (p. 27)			
10. For permanent fill roads, install culverts or bridges a maximum of 300 feet apart and at all natural drainageways. Install at least one drainage structure at each wetland crossing.			
11. For temporary roads, provide adequate cross-road drainage at all natural drainageways. Temporary drainage structures include culverts, bridges, and porous material such as corduroy or chunkwood. Temporary non-organic structures, such as metal culverts and bridges, should be removed when work is complete.			
12. Cease equipment operations when rutting becomes excessive.			
13. If necessary, use low ground pressure equipment to minimize rutting.			
14. If necessary, use corduroy, chunkwood, or rubber mats to improve the soil's ability to support traffic.			

Site Conditions

1. Landform of harvest area ___ flat ___ gently rolling ___ rolling hills
   (mark steepest applicable category) ___ steep ___ very steep
2. Dominant cover type ___ spruce-fir ___ maple-basswood ___ oak-hickory
   ___ pine plantation ___ aspen ___ bottomld hardwds
3. General soil texture: ___clay ___silt loam ___loam ___sandy loam ___loamy sand ___sand 4.

Soil drainage ___ poorly drained ___ somewhat poorly drained
___ moderately well-drained ___ well-drained ___ excessively drained

5. Slope range: _____% to _____%
6. Site erosion potential (based on soil texture and slope):
   ___ high ___moderate ___low

Water Resource(s) on-site

Name of water bodies, if known:_____

Where does the water source drain to: _____

What type of habitat does it provide (likely species, spawning habitat etc.): _____

___Wetland. Type:_____ Approximate size _____

___Lake. Approximate size _____

___Navigable stream (___perennial; ___intermittent) – Approximate width/depth: _____

Is the stream a trout stream? ___ yes; ___ no

If yes, what class? ___

___Non-navigable stream (___perennial; ___intermittent) – Approximate width/depth: _____

___Springs, approximate number _____

___Seeps, approximate number _____

Slope of harvested area closest to predominant water body? _____ %

Was a stream crossing rated ? ___yes; ___no

If yes, was a permit necessary? ___ yes; ___ no

If yes, was one obtained? ___ yes; ___ no

Timber Harvest

1. Approximate acres harvested _____
2. Harvest system used: clearcut shelterwood salvage thinning unknown other_____
3. Primary (merchantable) timber species harvested _____
4. Equipment used _____
5. Roads: New construction (total length)_____; Reconstruction (total length) _____
6. Length of road rated within or outside sale boundary: Within _____; Outside _____
7. What were some of the positive aspects of the timber sale?

8. What were some of the negative aspects of the timber sale that could have been done better?

Professional Judgment Ratings

Overall Rating
Rate this site from 1-5 for the overall application of BMPs _____

1 = total negligence, 2 = poor, 3 = average, 4 = good, 5 = excellent

Rate this site from 1-5 for its overall impact to water quality _____

1 = severe, 2 = moderate, 3 = slight, 4 = negligible, 5 = no visual impact

Combined Rating _____

Supplemental Questions for the NIPF Landowner

1. Does the landowner reside on the property that is being monitored? ___ yes ___ no

   If NO, how many miles does the landowner live from the property? _____

2. Is the land enrolled in any state/federal incentive/assistance programs? __ yes ___ no

   If YES, in which type of program is the property entered? (check all that apply)
   - ___ DNR Forestry Tax Law Program (MFL, FCL, WTL)
   - ___ Federal CRP Program
   - ___ Federal Stewardship Program (SIP, FIP)
   - ___ Wisconsin Forest Landowner Grant Program
   - ___ other state or federal program

3. Did the landowner have a written timber sale contract? ___ yes; ___ no

4. Did the landowner place any constraints on what the loggers could do on this site, such as avoiding certain areas or not cutting some species? ___ yes; ___ no

   If yes, were these constraints written into the timber sale contract or just verbal instructions? ___ written; ___ verbal

   Give examples of constraints:

5. Was a forester involved in setting up the timber sale? ___ yes; ___ no

   If YES, what type of forester set up the sale?
   - ___ DNR/County forester
   - ___ Private consultant
   - ___ Industrial forester

   What was the level of technical assistance:
   0 1 2 3 4 5 6 7 8 9 10
   (none) (forester present throughout entire sale)

6. Is this the first timber sale on the property by the current landowner? ___ yes; ___ no

7. What were the landowner's reasons for harvesting (check all that apply)?

   ___ approached by logger; ___ trees were mature; ___ land use conversion; ___ storm salvage

   ___ guidance from forester; ___ income; ___ timber stand improvement; ___ personal use of wood;

   ___ required by tax law management plan; ___ other: _____

8. During what month(s) did the timber harvesting take place (check all that apply)?

   ___ Jan; ___ Feb; ___ Mar; ___ Apr; ___ May; ___ June;

   ___ July; ___ Aug; ___ Sept; ___ Oct; ___ Nov; ___ Dec

9. Was the landowner familiar with forestry BMPs for water quality before the timber sale took place?

___ yes; ___ no

10. Did the landowner have any concerns about the timber sale with regard to maintaining water quality? ___ yes; ___ no

11. What is the landowner's objective for the property (check all that apply)?

___ timber production; ___ aesthetics; ___ wildlife habitat; ___ recreation; ___ residence;

___ investment; ___ to pass on to family members; ___ other: _____

12. Is the RMZ used for any purposes other than protecting water quality?
___ timber production; ___ hunting; ___ hiking; ___ other: _____

13. Are any of the woodlands part of an active farm? ___ yes; ___ no

If yes, are some of the woodlands used for grazing or pasture?

14. Was the landowner satisfied with the outcome of the timber harvest? ___ yes; ___ no

If no, why not?

Rate your level of satisfaction on a scale of 1-10: _____

15. Was the landowner present during the timber harvest? ___ yes; ___ no; ___ at times

If yes, approximately what % of the time? _____

16. Did implementing BMPs for water quality affect the value of the timber sale?

__ yes; __ no; ___they were not consciously applied

If YES, to what extent was the sale affected?

If BMPs for water quality were *not* applied, why not?

___ Logger/ landowner did not know about BMPs
___ Logger/ landowner did not know how to apply BMPs
___ No desire to implement BMPs
___ Too expensive to implement BMPs
___ Felt BMPs for water quality were not necessary
___ Other: _____

17. What resources would you be willing to use to learn more about forestry BMPs for water quality?

___ Workshops
___ Websites
___ Publications / booklets
___ Videos
___Other: _____

Appendix E: Guidelines for BMP Monitoring Teams – 2002

Guidelines for BMP Monitoring Teams – 2002

For Wisconsin's Forestry Best Management Practices for Water Quality Program

1. For "Application" rating "0" or "4", use "Effectiveness" rating "0 – Effectiveness rating not applicable".

2. When rating the effectiveness of a BMP with a "minor" or major" impact, be sure to provide notes in the "Comments" column on items such as quantity and duration, distance to the water resource, and the type of water resource.

3. If a BMP is being rated along more than one water resource (i.e. along two streams), the team should use their professional judgment and provide an average application and effectiveness rating for the BMP. Again, be sure to include important information about your decision in the "Comments" column next to the BMP.

4. If you suspect a BMP is or was needed, only rate a BMP that you can see or have reliable information about; otherwise, use "Application" rating "4 – Insufficient information to rate".

5. Where feasible, evaluate the entire timber sale, even though portions of the sale (a) may not be on a wetland or (b) may be greater than 200 feet from a stream or lake. Fore large sales, time constraints will make it essential for the team to concentrate on areas with the greatest impact to water quality (such as on wetlands, along streams and lakes, and on forest roads).

6. In a situation where a portion of a road, skid trail, or other activity on a sale causes erosion but the runoff does not drain towards a surface water feature, the BMP "Application" rating is still applicable to the site and should be evaluated. The "Application" rating will either be "1-BMP applied correctly", "2 - BMP applied but incorrectly", or "3 - BMP not applied". In these cases, the BMP "Effectiveness" rating would be "1 - No adverse impact" since there is no potential impact to water quality.

7. Audit only the length of haul road constructed or reconstructed for this timber sale, regardless of whether the haul road is within or outside of the timber sale boundary. If an existing road is used without reconstruction, the road maintenance BMPs are still applicable to this road.

8. Active Roads are those that continue to be used by the landowner(s) and or public for multiple uses, including forest management, hunting, and recreation. Inactive Roads are those that are closed by berms, boulders, pits, or other measures that make vehicle passage most unlikely.

9. Evaluate the site only for forest activities or roads used by the logger in 2001-2002.

10. When evaluating Wisconsin DNR lands, DNR team members can help rate the timber sale, but can not be the team recorder for the sale.

11. Any person who set-up and/or administered the timber sale (including DNR personnel) should not participate in rating the sale, except to answer questions from team members about the sale.

12. For each timber sale, one audit worksheet should be completed and written *in pen* by one team member (cross out any changes and do not erase information). Everyone on a team should have an opportunity to be the "team recorder" for at least one timber sale during the week of monitoring.

13. People who are not monitoring team members are welcome to observe the teams, but they (a) must pay for their own expenses and (b) can not rate BMPs. Only the 2002 BMP Monitoring Team members can rate BMPs.

14. Remember:

    a) We are evaluating BMPs and activities that may impact water quality, aquatic ecosystems, fish and other aquatic life. We are not rating aesthetics.
    b) Information from this monitoring will help us improve the BMP manual as well as education and training workshops. Do not try to rate something that is not in the BMP field manual, but feel free to make notes on how we can improve the manual or our educational efforts.
    c) We are not rating fault. We are simply rating existing conditions.
    d) Thanks for your help and have fun.

Appendix F: 2002 Monitoring Results for Individual BMPs

	Application Ratings		Effectiveness Ratings				
BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
SUMMARY OF ALL RAW DATA	Not Applicable	8575					
	Insufficient Info.	109					
	Applied Correctly	1878	1856	1	14	0	1
	Applied Incorrectly	65	23	14	19	0	9
	Not Applied	253	63	18	106	0	66
Fuels, Lubricants, Wastes and Spills							
A1	Not Applicable	1					
Designate specific areas for equipment	Insufficient Info.	25					
maintenance and fueling. Locate these areas on							
level terrain, a minimum of 100 feet from all	Applied Correctly	59	59	0	0	0	0
streams and lakes.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
A2	Not Applicable	1					
Collect all waste lubricants, containers, and	Insufficient Info.	7					
trash (i.e. grease cartridges).							
	Applied Correctly	74	74	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	2	0	1	0	0
Riparian Management Zones							
B1	Not Applicable	33					
Construct or use existing roads outside the	Insufficient Info.	0					
RMZ, unless necessary for stream crossings.							
	Applied Correctly	49	48	0	1	0	0
	Applied Incorrectly	2	2	0	0	0	0
	Not Applied	1	1	0	0	0	0
B2	Not Applicable	28					
Construct or use existing landings outside the	Insufficient Info.	1					
RMZ.							
	Applied Correctly	55	55	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
B3	Not Applicable	27					
Do not move slash into or pile slash within the	Insufficient Info.	0					
RMZ. Keep slash out of lakes and stream							
channels and away from areas where it may be	Applied Correctly	43	43	0	0	0	0
swept into the water.	Applied Incorrectly	3	3	0	0	0	0
	Not Applied	12	4	1	7	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
B4	Not Applicable	27					
Minimize soil exposure and compaction to	Insufficient Info.	2					
protect ground vegetation and the duff layer.							
	Applied Correctly	52	52	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	0	0	4	0	0
B5	Not Applicable	39					
Do not operate wheeled or tracked harvesting	Insufficient Info.	0					
equipment within 50 feet of the ordinary high-							
water mark except on roads or at stream	Applied Correctly	33	33	0	0	0	0
crossings.	Applied Incorrectly	2	2	0	0	0	0
	Not Applied	11	6	1	4	0	0
B6	Not Applicable	41					
Use selective harvesting and promote long-lived	Insufficient Info.	1					
tree species appropriate to the site: i.e.							
sugar/red maple, oaks, white/black ash,	Applied Correctly	36	36	0	0	0	0
hemlock, white/red pine and white cedar.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	7	2	1	3	0	1
B7	Not Applicable	41					
Harvesting intervals should be no more frequent	Insufficient Info.	3					
than every 10 years.							
	Applied Correctly	41	41	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
B8	Not Applicable	41					
Do not reduce basal area below 60 ft^2 per acre	Insufficient Info.	0					
in trees 5-inches DBH and larger, evenly							
distributed.	Applied Correctly	31	31	0	0	0	0
	Applied Incorrectly	3	2	0	1	0	0
	Not Applied	10	5	1	3	0	1
B9	Not Applicable	43					
Develop trees 12 inches DBH and larger.	Insufficient Info.	0					
	Applied Correctly	33	33	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	8	3	1	3	0	1

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
B10	Not Applicable	77					
Operate wheeled or tracked harvesting	Insufficient Info.	0					
equipment within 15 feet of the ordinary high-							
water mark only when the ground is frozen or	Applied Correctly	6	6	0	0	0	0
dry.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	1	0	0	0
B11	Not Applicable	77					
Use selective harvesting and promote long-lived	Insufficient Info.	0					
tree species appropriate to the site.							
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	0	0
B12	Not Applicable	77					
Harvesting intervals should be no more frequent	Insufficient Info.	1					
than every 10 years.							
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
B13	Not Applicable	77					
Do not reduce basal area below 60 ft^2 per acre	Insufficient Info.	0					
in trees 5-inches DBH and larger, evenly							
distributed.	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	1	0	0	0
B14	Not Applicable	69					
Operate wheeled or tracked harvesting	Insufficient Info.	1					
equipment within 15 feet of the ordinary high-							
water mark only when the ground is frozen or	Applied Correctly	13	13	0	0	0	0
dry.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	2	0	0	0
Forest Roads							
C1	Not Applicable	26					
Use existing roads when they provide the best	Insufficient Info.	2					
long-term access. Consider relocating existing							
roads if doing so improves access and reduces	Applied Correctly	55	54	0	1	0	0
environmental impacts.	Applied Incorrectly	2	0	0	0	0	2
	Not Applied	0	0	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C2	Not Applicable	54					
Plan road systems that minimize the number,	Insufficient Info.	2					
width, and length of roads to limit the total area							
of the site disturbed.	Applied Correctly	27	26	0	1	0	0
	Applied Incorrectly	1	0	0	0	0	1
	Not Applied	1	0	0	1	0	0
C3	Not Applicable	61					
Select road locations that allow for drainage	Insufficient Info.	1					
away from the road.							
	Applied Correctly	19	19	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	2	0	1	0	1
C4	Not Applicable	62					
Where possible, locate roads on well-drained	Insufficient Info.	1					
soils.							
	Applied Correctly	22	22	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C5	Not Applicable	73					
If road grades > 10% are necessary, limit grade	Insufficient Info.	1					
length or break the grade using drainage							
structures.	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	2	0	0	1	0	1
C6	Not Applicable	69					
Construct roads to follow natural contours and	Insufficient Info.	1					
minimize cut and fills. Balance cut and fills to							
minimize the need for fill or removing excess	Applied Correctly	12	12	0	0	0	0
materials.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	1	0	1	0	1
C7	Not Applicable	71					
Minimize the number of stream crossings.	Insufficient Info.	0					
	Applied Correctly	14	13	0	1	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C8	Not Applicable	75					
Identify optimum stream-crossing locations:	Insufficient Info.	0					
straight and narrow stream channels; low banks;							
firm rocky soil; keep approaches at the least	Applied Correctly	9	8	0	1	0	0
gradient possible.	Applied Incorrectly	1	0	0	0	0	1
	Not Applied	0	0	0	0	0	0
C9	Not Applicable	75					
Design, construct, and maintain stream	Insufficient Info.	1					
crossings to avoid disrupting the							
migration/movement of aquatic life.	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	2	0	0	1	0	1
C10	Not Applicable	77					
Install stream crossings using materials that are	Insufficient Info.	0					
clean, non-erodible, and non-toxic to aquatic							
life.	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	1	0	0	0	0	1
C11	Not Applicable	77					
Install stream-crossing structures at right angles	Insufficient Info.	0					
to the stream channel.							
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	1	0	1
C12	Not Applicable	76					
Minimize channel changes and the amount of	Insufficient Info.	0					
excavation or fill needed at the crossing.							
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	1	0	1
C13	Not Applicable	77					
Limit construction activity in the water to periods	Insufficient Info.	1					
of low or normal flow.							
	Applied Correctly	6	5	0	1	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	0	0	1

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C14	Not Applicable	77					
Keep use of equipment in the stream to a minimum.	Insufficient Info.	0					
	Applied Correctly	7	6	0	1	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	0	0	1
C15	Not Applicable	76					
Construct a bridge or place fill directly over a culvert higher than the road approach to prevent surface road runoff from draining onto the crossing structure and into the stream.	Insufficient Info.	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	2	0	1	1	0	0
	Not Applied	5	1	0	3	0	1
C16	Not Applicable	77					
Divert road drainage into undisturbed vegetation, so that the drainage does not directly enter the stream.	Insufficient Info.	0					
	Applied Correctly	4	3	1	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	0	0	3	0	1
C17	Not Applicable	76					
Stabilize approaches to bridge, culvert, and ford crossings with aggregate or other suitable material.	Insufficient Info.	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	1	0	0	0	0	1
	Not Applied	2	0	0	2	0	0
C18	Not Applicable	85					
Anchor temporary structures on one end with a cable or other device so they do not float away during high water.	Insufficient Info.	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C19	Not Applicable	80					
Install pipe culverts long enough so road fill does not extend beyond the ends of the culvert.	Insufficient Info.	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	2	0	1	1	0	0
	Not Applied	0	0	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C20	Not Applicable	80					
Install permanent culverts that have a minimum diameter of 12 inches.	Insufficient Info.	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C21	Not Applicable	80					
Install culverts so there is no change in the stream bottom elevation. Culverts should not cause damming or pooling.	Insufficient Info.	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C22	Not Applicable	78					
Cover the top of culverts with fill to a depth of one-third the pipe diameter, or at least or at least 12 inches (which ever is greater) to prevent crushing.	Insufficient Info.	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C23	Not Applicable	80					
Use riprap around the inlet of culverts. For permanent installations, use filter fabric under the riprap.	Insufficient Info.	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
C24	Not Applicable	78					
Keep culverts clear and free of debris.	Insufficient Info.	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C25	Not Applicable	82					
Locate fords where streambanks are low.	Insufficient Info.	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C26	Not Applicable	82					
Streambed should have a firm rock or gravel	Insufficient Info.	0					
base. If not, install stabilizing material such as							
reinforced concrete planks, crushed rock, riprap,	Applied Correctly	1	1	0	0	0	0
or rubber mats on streambeds.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	1	0	1
C27A	Not Applicable	77					
Construct roads to remove water from road	Insufficient Info.	0					
surfaces by crowning.							
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	0	0	0	1
C27B	Not Applicable	80					
Construct roads to remove water from road	Insufficient Info.	0					
surfaces by outsloping.							
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	0	0	0	1
C27C	Not Applicable	81					
Construct roads to remove water from road	Insufficient Info.	0					
surfaces by insloping with ditches and cross							
drainage.	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	0	0	0	1
C28	Not Applicable	80					
Construct stable cut and fill slopes that will	Insufficient Info.	0					
revegetate easily, either naturally or artificially.							
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	3	1	0	1	0	1
C29	Not Applicable	75					
Do not bury debris in the road base.	Insufficient Info.	1					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	0	0	0	1

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C30	Not Applicable	81					
Surface the road with gravel where steep	Insufficient Info.	0					
grades, erodible soils, or high-traffic volume							
make the potential for surface erosion	Applied Correctly	2	2	0	0	0	0
significant.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	0	0	0	1
C31	Not Applicable	82					
Install pipe culverts to provide cross drainage on	Insufficient Info.	0					
road grades at recommended intervals (Table 6-							
1,p. 29) immediately above steep grades, below	Applied Correctly	2	2	0	0	0	0
bank seepages, and where water will run onto	Applied Incorrectly	0	0	0	0	0	0
log landings or forest roads.	Not Applied	1	0	0	1	0	0
C32	Not Applicable	83					
Install pipe culverts long enough so road fill	Insufficient Info.	0					
does not extend beyond the end of a culvert.							
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C33	Not Applicable	84					
Install pipe culverts at grades at least 2% more	Insufficient Info.	0					
than the ditch grade and angled 30-45º to							
improve inlet efficiency (Figure 6-9).	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C34	Not Applicable	83					
Select the size of cross-drain culverts according	Insufficient Info.	0					
to the size of the road and area drained by the							
ditch. Permanent culverts should be 12-inch	Applied Correctly	1	1	0	0	0	0
minimum diameter.	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	0	0	0	0	0	0
C35	Not Applicable	83					
Cover the top of the culvert with fill to a depth of	Insufficient Info.	0					
1/3 of the pipe diameter or at least 12 inches,							
whichever is greater.	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C36	Not Applicable	85					
Use riprap around the inlet of culverts to prevent water from eroding and undercutting the culvert.	Insufficient Info.	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C37	Not Applicable	85					
Open-top culverts should be installed only on seasonal or temporary roads.	Insufficient Info.	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C38	Not Applicable	85					
Install open-top culverts to provide cross drainage immediately above steep grades,	Insufficient Info.	0					
below bank seepages, where water will run onto	Applied Correctly	0	0	0	0	0	0
log landings or forest roads, and on road grades	Applied Incorrectly	0	0	0	0	0	0
at recommended intervals (Table 6-1, p. 29).	Not Applied	0	0	0	0	0	0
C39	Not Applicable	85					
Clean open-top culverts frequently.	Insufficient Info.	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C40	Not Applicable	82					
Install broad-based dips where necessary to provide cross drainage and road-surface	Insufficient Info.	0					
drainage for roads with a gradient of 15% or	Applied Correctly	1	1	0	0	0	0
less.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	1	0	1
C41							
	Not Applicable	84					
Construct broad-based dips deep enough to provide adequate drainage and wide enough to	Insufficient Info.	0					
allow trucks and equipment to pass safely.	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C42	Not Applicable	84					
Place a surface of crushed stone or gravel on the dip and mound for soils and conditions where rutting may occur.	Insufficient Info.	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C43	Not Applicable	80					
Install water bars where necessary to provide cross drainage and road surface drainage.	Insufficient Info.	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	2	0	0	1	0	1
C44	Not Applicable	82					
Place water bars at a 30-45º angle with a cross drainage grade of 2%.	Insufficient Info.	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	0	0	0	0	0	0
C45	Not Applicable	80					
Install diversion ditches where necessary to divert runoff away from roads and side ditches and channel it into vegetation before the runoff enters a stream, lake or wetland.	Insufficient Info.	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	1	0	0	0	2
C46	Not Applicable	81					
Construct diversion ditches so they intersect the roadside ditch at the same depth and are outsloped 1-3% (Figure 6-4).	Insufficient Info.	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	0	1	0	0
C47	Not Applicable	75					
Use mulch and/or seed where necessary to minimize soil erosion into streams, lakes, and wetlands.	Insufficient Info.	1					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	1	0	0	0	0	1
	Not Applied	4	0	0	3	0	1

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C48A	Not Applicable	83					
Install sediment control structures where	Insufficient Info.	0					
necessary to slow runoff and trap sediment until							
vegetation is established at the sediment	Applied Correctly	0	0	0	0	0	0
source: silt fencing for sheet flow.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	0	0	2
C48B	Not Applicable	83					
Install sediment control structures where	Insufficient Info.	0					
necessary to slow runoff and trap sediment until							
vegetation is established at the sediment	Applied Correctly	0	0	0	0	0	0
source: straw bales for sheet and channelized	Applied Incorrectly	0	0	0	0	0	0
flow.	Not Applied	2	0	0	0	0	2
C49	Not Applicable	85					
Maintain, clean, or replace sediment-control	Insufficient Info.	0					
structures until areas of exposed soil are							
stabilized.	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C50	Not Applicable	75					
Clear debris from drainage structures. Place the	Insufficient Info.	0					
debris where it cannot be washed back into							
these structures or into open water.	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
C51	Not Applicable	52					
Keep traffic to a minimum during wet periods	Insufficient Info.	2					
and spring breakup.							
	Applied Correctly	29	29	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	1	0	1
C52	Not Applicable	59					
Shape road surfaces periodically to maintain	Insufficient Info.	1					
proper surface drainage. Fill in ruts and holes							
with gravel or compacted fill as soon as	Applied Correctly	19	19	0	0	0	0
possible.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	6	2	0	2	0	2

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
C53	Not Applicable	70					
Remove berms along the edge of the road if they will trap water on the road.	Insufficient Info.	0					
	Applied Correctly	13	13	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	1	0	1
C54	Not Applicable	83					
Remove all temporary drainage and stream crossing structures.	Insufficient Info.	2					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C55	Not Applicable	85					
When dust control agents are used, apply them in a manner that will keep these compounds	Insufficient Info.	0					
from entering lakes, streams and groundwater.	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C56	Not Applicable	82					
Shape all road system surfaces to maintain proper surface drainage, if necessary.	Insufficient Info.	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
C57	Not Applicable	83					
Inspect and maintain road surfaces, permanent drainage and stream-crossing structures	Insufficient Info.	1					
(ditches, culverts, bridges, etc.)	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

Timber Harvesting

D1	Not Applicable	7					
Limit the length and number of skid trails, and the number of landings and stream crossings	Insufficient Info.	0					
	Applied Correctly	74	73	0	1	0	0
	Applied Incorrectly	3	1	1	0	0	1
	Not Applied	1	1	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
D2	Not Applicable	66					
Whenever possible, winch logs from steep	Insufficient Info.	0					
slopes if skidding could cause erosion that							
affects water quality.	Applied Correctly	19	18	0	1	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
D3	Not Applicable	9					
Avoid operating equipment where excessive soil	Insufficient Info.	0					
compaction and rutting occurs.							
	Applied Correctly	68	67	1	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	7	1	1	4	0	1
D4	Not Applicable	16					
Do not pile slash into drainage areas where	Insufficient Info.	0					
runoff may wash slash into streams, lakes, or							
wetlands.	Applied Correctly	63	63	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	5	1	1	3	0	0
D5	Not Applicable	16					
Use existing landings if possible.	Insufficient Info.	8					
	Applied Correctly	60	60	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
D6	Not Applicable	80					
Close existing landings in RMZs unless	Insufficient Info.	0					
construction of new landings will cause greater							
harm to water quality than using existing	Applied Correctly	5	5	0	0	0	0
landings.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
D7	Not Applicable	26					
Locate landings outside RMZs.	Insufficient Info.	0					
	Applied Correctly	58	58	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
D8	Not Applicable	8					
Locate landings on frozen ground or on firm	Insufficient Info.	1					
well-drained soils with a slight slope, or on							
ground shaped to promote drainage.	Applied Correctly	75	75	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	0	0	0	0	0	0
D9	Not Applicable	21					
Locate residue piles (sawdust, field chipping	Insufficient Info.	0					
residue, cull logs, etc.) away from drainages							
where runoff may wash residue into streams,	Applied Correctly	62	62	0	0	0	0
lakes, or wetlands.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	2	0	0	0	0
D10A	Not Applicable	68					
To prevent erosion and sedimentation into	Insufficient Info.	4					
surface water, fill in ruts.							
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	1	0	2	0	1
D10B	Not Applicable	74					
To prevent erosion and sedimentation into	Insufficient Info.	2					
surface water, seed and mulch.							
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	1	0	1	0	1
D10C	Not Applicable	79					
To prevent erosion and sedimentation into	Insufficient Info.	0					
surface water, install sediment control							
structures.	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	2	0	0	1	0	1
D11	Not Applicable	45					
Where possible, keep skid trail grades < 15%.	Insufficient Info.	0					
Where steep grades are unavoidable, break the							
grade and install drainage structures at	Applied Correctly	37	37	0	0	0	0
recommended intervals (Table 6-1, p.29).	Applied Incorrectly	3	2	1	0	0	0
Grades > 15% should not exceed 300 feet in	Not Applied	0	0	0	0	0	0
length.							

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
D12A	Not Applicable	67					
To prevent erosion and sedimentation into surface water, fill in ruts.	Insufficient Info.	2					
	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	2	0	1	1	0	0
	Not Applied	6	2	1	2	0	1
D12B	Not Applicable	67					
To prevent erosion and sedimentation into surface water, seed and mulch.	Insufficient Info.	1					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	7	2	2	2	0	1
D12C	Not Applicable	73					
To prevent erosion and sedimentation into surface water, install sediment control structures.	Insufficient Info.	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	2	0	2	0	0	0
	Not Applied	5	2	0	2	0	1
D13	Not Applicable	67					
Minimize the number of stream crossings.	Insufficient Info.	0					
	Applied Correctly	18	17	0	1	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
D14	Not Applicable	71					
Identify optimum stream-crossing locations: straight and narrow channels; low banks; firm rocky soil; keep approaches at the least gradient possible.	Insufficient Info.	0					
	Applied Correctly	13	11	1	1	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	0	0	0	0	0	0
D15	Not Applicable	74					
Design, construct, and maintain stream crossings to avoid disrupting migration/movement of aquatic life.	Insufficient Info.	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	4	0	0	2	0	2

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
D16	Not Applicable	78					
Install stream crossings using materials that are	Insufficient Info.	0					
clean, non-erodible and non-toxic to aquatic life.							
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	1	0	1
D17	Not Applicable	78					
Install stream-crossing structures at right angles	Insufficient Info.	0					
to the stream channel.							
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	1	0	0	1	0	0
D18	Not Applicable	75					
Minimize channel changes and the amount of	Insufficient Info.	0					
excavation or fill needed at the crossing.							
	Applied Correctly	7	6	0	1	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	2	0	0	1	0	1
D19	Not Applicable	77					
Limit construction activity in the water to periods	Insufficient Info.	3					
of low or normal flow.							
	Applied Correctly	4	3	0	1	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	0	0	1
D20	Not Applicable	73					
Keep use of equipment in the stream to a	Insufficient Info.	0					
minimum.							
	Applied Correctly	10	9	1	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	1	0	1
D21	Not Applicable	81					
Construct a bridge or place fill directly over a	Insufficient Info.	1					
culvert higher than the trail approach to prevent							
surface road runoff from draining onto the	Applied Correctly	0	0	0	0	0	0
crossing structure and into the stream.	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	2	0	0	2	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
D22	Not Applicable	77					
Divert trail drainage into undisturbed vegetation, so that the drainage does not directly enter the stream.	Insufficient Info.	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	5	1	0	3	0	1
D23	Not Applicable	80					
Stabilize approaches to bridge, culvert, and ford crossings with aggregate or other suitable material.	Insufficient Info.	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	0	0	2	0	1
D24	Not Applicable	84					
Anchor temporary structures on one end with a cable or other device so they do not float away during high water.	Insufficient Info.	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	0	0	1
D25	Not Applicable	85					
Install pipe culverts long enough so fill does not extend beyond the ends of a culvert.	Insufficient Info.	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
D26	Not Applicable	85					
Install permanent culverts that have a minimum diameter of 12 inches.	Insufficient Info.	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
D27	Not Applicable	85					
Install culverts so there is no change in the stream bottom elevation.	Insufficient Info.	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
D28	Not Applicable	83					
Cover the top of culverts with fill to a depth of	Insufficient Info.	0					
1/3 of the pipe diameter or at least 12 inches,							
whichever is greater.	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	1	0	0	1	0	0
D29	Not Applicable	85					
Use riprap around the inlet of culverts. For	Insufficient Info.	0					
permanent installations, use filter fabric under							
the riprap.	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
D30	Not Applicable	83					
Keep culverts clear and free of debris.	Insufficient Info.	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
D31	Not Applicable	75					
Use fords for crossing dry streambeds or where	Insufficient Info.	0					
fording minimizes water quality impacts.							
	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	0	0	0	1
D32	Not Applicable	76					
Locate fords where streambanks are low.	Insufficient Info.	0					
	Applied Correctly	9	8	0	0	0	1
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
D33	Not Applicable	75					
Streambed should have a firm rock or gravel	Insufficient Info.	0					
base. If not, install stabilizing material such as							
reinforced concrete planks, crushed rock, riprap,	Applied Correctly	7	7	0	0	0	0
or rubber mats on streambeds.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	1	0	1	0	1

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
D34	Not Applicable	82					
Pole fords must be removed immediately after use or before the upstream end becomes clogged with debris and impedes streamflow.	Insufficient Info.	2					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	0	0	1

Wetlands

E1	Not Applicable	34					
Whenever practical, avoid constructing roads and landings in wetlands; otherwise use extreme caution.	Insufficient Info.	0					
	Applied Correctly	48	47	0	1	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	2	0	0	0	0	2
E2	Not Applicable	49					
Forest management activities in wetlands should occur on firm ground (frozen or dry).	Insufficient Info.	1					
	Applied Correctly	31	31	0	0	0	0
	Applied Incorrectly	2	0	0	2	0	0
	Not Applied	2	0	0	1	0	1
E3	Not Applicable	28					
Do not move slash from upland sites into a wetland.	Insufficient Info.	0					
	Applied Correctly	52	52	0	0	0	0
	Applied Incorrectly	2	1	0	1	0	0
	Not Applied	3	1	0	1	0	1
E4	Not Applicable	43					
Keep slash out of open water.	Insufficient Info.	0					
	Applied Correctly	38	38	0	0	0	0
	Applied Incorrectly	2	1	0	1	0	0
	Not Applied	2	0	0	2	0	0
E5	Not Applicable	30					
Avoid equipment maintenance and fueling in wetlands.	Insufficient Info.	6					
	Applied Correctly	49	49	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
E6	Not Applicable	67					
Construct upland road and trail approaches to wetlands so that surface runoff is diverted away	Insufficient Info.	2					
from the road so the runoff does not enter the	Applied Correctly	9	9	0	0	0	0
wetland.	Applied Incorrectly	2	2	0	0	0	0
	Not Applied	5	2	0	1	0	2
E7	Not Applicable	79					
If landings are necessary in a wetland, build them to the minimum size required for the	Insufficient Info.	2					
operation.	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
E8	Not Applicable	54					
Avoid operating equipment in areas of open water, springs or seeps.	Insufficient Info.	1					
	Applied Correctly	28	27	1	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	1	0	0	0	0	1
E9	Not Applicable	67					
Provide for adequate cross-road drainage to minimize changes to natural surface and	Insufficient Info.	1					
subsurfaceflow in the wetland.	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	2	0	0	1	0	1
	Not Applied	5	1	0	3	0	1
E10	Not Applicable	80					
For permanent fill roads, install culverts or bridges a maximum of 300 feet apart and at all	Insufficient Info.	0					
natural drainageways. Install at least one	Applied Correctly	1	1	0	0	0	0
drainage structure at each wetland crossing.	Applied Incorrectly	3	0	0	2	0	1
	Not Applied	1	0	0	0	0	1
E11	Not Applicable	80					
For temporary roads, provide adequate cross-road drainage at all natural drainageways.	Insufficient Info.	0					
Temporary drainage structures include culverts,	Applied Correctly	3	3	0	0	0	0
bridges, and porous material such as corduroy	Applied Incorrectly	0	0	0	0	0	0
or chunkwood. Temporary non-organic	Not Applied	2	0	0	1	0	1
structures, such as metal culverts and bridges, should be removed when work is complete.							

BMP	BMP Application	Total	No Adverse Impact	Minor Short Term	Minor Long Term	Major Short Term	Major Long Term
E12	Not Applicable	49					
Cease equipment operations when rutting becomes excessive.	Insufficient Info.	2					
	Applied Correctly	25	24	1	0	0	0
	Applied Incorrectly	2	0	1	1	0	0
	Not Applied	7	0	1	5	0	1
E13	Not Applicable	67					
If necessary, use low ground pressure equipment to minimize rutting.	Insufficient Info.	9					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	5	0	1	3	0	1
E14	Not Applicable	77					
If necessary, use corduroy, chunkwood, or rubber mats to improve the soil's ability to support traffic.	Insufficient Info.	2					
	Applied Correctly	2	1	1	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	0	1	2	0	1


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